



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL PROJECT

COSTS AND BENEFITS OF UNIFORM COMMONALITY FOR THE NAVY AND MARINE CORPS

June 2018

**By: Bryce Hicks
Jason House
Varsha Styer**

**Advisors: Spencer T. Brien
Robert F. Mortlock**

Approved for public release. Distribution is unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

| | | | | |
|---|---|--|---|---|
| REPORT DOCUMENTATION PAGE | | | <i>Form Approved OMB No. 0704-0188</i> | |
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503. | | | | |
| 1. AGENCY USE ONLY (Leave blank) | | 2. REPORT DATE June 2018 | | 3. REPORT TYPE AND DATES COVERED MBA Professional Project |
| 4. TITLE AND SUBTITLE COSTS AND BENEFITS OF UNIFORM COMMONALITY FOR THE NAVY AND MARINE CORPS | | | 5. FUNDING NUMBERS | |
| 6. AUTHOR(S) Bryce Hicks, Jason House, and Varsha Styer | | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000 | | | 8. PERFORMING ORGANIZATION REPORT NUMBER | |
| 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A | | | 10. SPONSORING / MONITORING AGENCY REPORT NUMBER | |
| 11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. | | | | |
| 12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release. Distribution is unlimited. | | | 12b. DISTRIBUTION CODE A | |
| 13. ABSTRACT (maximum 200 words) <p>This research used uniforms of the United States Navy and Marine Corps to explain the costs and benefits of the services consolidating uniforms and wearing a single functional uniform. This study examined the history of Navy and Marine Corps uniforms. It analyzed benefits and costs, as well as identified impediments to implementing a single functional uniform for use at Contiguous United States (CONUS) and Outside Continental United States (OCONUS) duty stations. The research team concluded that there are many possible benefits to consolidation such as increased concealment, safety, and functionality. After analyzing eight possible courses of action (COA), the research team concluded that COA 4, both the Navy and Marine Corps utilizing the Marine Corps Combat Utility Uniform (MCCUU) Flame Resistant (FR) variant, resulted in the greatest number of benefits and the highest weight of perceived benefits to the warfighter.</p> | | | | |
| 14. SUBJECT TERMS uniforms, camouflage, Navy Working Uniform, NWU, Marine Corps Combat Utility Uniform, MCCUU, cost benefit analysis, CBA | | | 15. NUMBER OF PAGES 87 | |
| | | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified | 20. LIMITATION OF ABSTRACT UU | |

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release. Distribution is unlimited.

**COSTS AND BENEFITS OF UNIFORM COMMONALITY FOR THE NAVY
AND MARINE CORPS**

Bryce Hicks, Lieutenant, United States Navy
Jason House, Lieutenant, United States Navy
Varsha Styer, Lieutenant, United States Navy

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

**NAVAL POSTGRADUATE SCHOOL
June 2018**

Approved by: Spencer T. Brien
Advisor

Robert F. Mortlock
Advisor

Rene G. Rendon
Academic Associate
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

COSTS AND BENEFITS OF UNIFORM COMMONALITY FOR THE NAVY AND MARINE CORPS

ABSTRACT

This research used uniforms of the United States Navy and Marine Corps to explain the costs and benefits of the services consolidating uniforms and wearing a single functional uniform. This study examined the history of Navy and Marine Corps uniforms. It analyzed benefits and costs, as well as identified impediments to implementing a single functional uniform for use at Contiguous United States (CONUS) and Outside Continental United States (OCONUS) duty stations. The research team concluded that there are many possible benefits to consolidation such as increased concealment, safety, and functionality. After analyzing eight possible courses of action (COA), the research team concluded that COA 4, both the Navy and Marine Corps utilizing the Marine Corps Combat Utility Uniform (MCCUU) Flame Resistant (FR) variant, resulted in the greatest number of benefits and the highest weight of perceived benefits to the warfighter.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

| | | |
|-----------------|--|---------------|
| I. | INTRODUCTION..... | 1 |
| A. | PROBLEM STATEMENT | 1 |
| B. | RESEARCH QUESTIONS..... | 2 |
| C. | PURPOSE | 2 |
| D. | ORGANIZATION..... | 4 |
| II. | BACKGROUND | 5 |
| A. | INTRODUCTION TO CAMOUFLAGE | 5 |
| B. | NON-SERVICE SPECIFIC CAMOUFLAGE UNIFORMS USED BY AMERICAN FORCES..... | 6 |
| 1. | Olive Green Shade 107 | 7 |
| 2. | Tiger Stripe..... | 8 |
| 3. | Engineer Research and Development Lab | 9 |
| 4. | Woodland Camouflage Utility Uniform..... | 10 |
| 5. | Desert Battle Dress Uniform | 11 |
| 6. | Desert Camouflage Uniform | 12 |
| C. | USMC SPECIFIC UNIFORMS | 13 |
| 1. | Marine Corps Combat Utility Uniforms..... | 13 |
| 2. | Flame Resistant Marine Corps Combat Utility Uniforms | 15 |
| 3. | Future Tropical Uniform | 15 |
| D. | USN SPECIFIC UNIFORMS | 16 |
| 1. | Navy Working Uniform Type I | 17 |
| 2. | Navy Working Uniform Type II..... | 18 |
| 3. | Navy Working Uniform Type III | 20 |
| 4. | Flame Resistant Navy Working Uniforms..... | 21 |
| 5. | Flame Resistant Variant Coveralls and Flight Suits | 21 |
| E. | CAMOUFLAGE IN MAJOR LEAGUE BASEBALL | 23 |
| F. | SUMMARY | 25 |
| III. | LITERATURE REVIEW | 27 |
| A. | BACKGROUND | 27 |
| 1. | Navy Exchange Service Command (NEXCOM)..... | 28 |
| 2. | Marine Corps Systems Command (MARCORSYSCOM) | 30 |
| 3. | Naval Facility Engineering Command (NAVFAC) | 30 |
| 4. | U.S. Army Natick Soldier Research, Development & Engineering Center (NSRDEC)..... | 30 |

| | | |
|-----|---|----|
| 5. | Defense Logistics Agency (DLA) Troop Support Clothing and Textiles..... | 31 |
| B. | UNIFORM FINDINGS | 31 |
| 1. | Marine Corps Combat Utility Uniform | 31 |
| 2. | Navy Working Uniform (NWU) Type I..... | 34 |
| 3. | Navy Working Uniform (NWU) Type II and Type III..... | 35 |
| IV. | METHODOLOGY | 37 |
| A. | COST BENEFIT ANALYSIS MODEL..... | 37 |
| 1. | History of CBA | 37 |
| 2. | Steps of CBA..... | 38 |
| B. | DATA ANALYSIS | 41 |
| 1. | Courses of Action (COA)..... | 41 |
| 2. | Benefits..... | 42 |
| 3. | Costs | 43 |
| 4. | Identify Impediments..... | 44 |
| 5. | Data Analysis..... | 46 |
| 6. | Sensitivity Analysis | 52 |
| 7. | Cost..... | 54 |
| 8. | COA Comparison Analysis | 56 |
| V. | SUMMARY, CONCLUSIONS, RECOMMENDATIONS | 59 |
| A. | SUMMARY | 59 |
| 1. | Conclusions..... | 60 |
| 2. | Recommendations | 61 |
| | LIST OF REFERENCES..... | 63 |
| | INITIAL DISTRIBUTION LIST | 69 |

LIST OF FIGURES

| | | |
|------------|---|----|
| Figure 1. | Pattern 41 camouflage..... | 6 |
| Figure 2. | OG-107 camouflage. Source: “Utilities/Jungle Fatigue” (n.d.). | 8 |
| Figure 3. | Tiger Stripe camouflage pattern. Source: Collins (n.d.). | 9 |
| Figure 4. | ERDL camouflage pattern. Source: “Utilities/Jungle Fatigue” (n.d.). | 10 |
| Figure 5. | Woodland camouflage utility uniform pattern. Source: Double Tap Military Surplus (n.d.)..... | 11 |
| Figure 6. | DBDU camouflage pattern. Adapted from Smithsonian National Museum of American History (n.d.). | 12 |
| Figure 7. | DCU camouflage pattern. Source: CIA (2012)..... | 13 |
| Figure 8. | Woodland and desert MCCUU patterns. Source: Marine Corps Base Camp Pendleton (2008). | 15 |
| Figure 9. | Possible MCCUU tropical uniform pattern. Source: Marine Corps Systems Command (2017)..... | 16 |
| Figure 10. | NWU Type I camouflage pattern..... | 18 |
| Figure 11. | NWU Type II camouflage pattern. Adapted from Navy Personnel Command (n.d.). | 19 |
| Figure 12. | NWU Type III camouflage pattern | 21 |
| Figure 13. | IFRV coverall. Source: Virginian Pilot (2017)..... | 23 |
| Figure 14. | Navy flight suit | 23 |
| Figure 15. | 2018 San Diego Padres MCCUU desert pattern camouflage alternate jersey. Source: Major League Baseball Shop (2018)..... | 25 |
| Figure 16. | 1952–Present timeline of Navy and Marine Corps uniforms. | 26 |
| Figure 17. | NEXCOM Uniform Program Division Organizational Chart. Adapted from Navy Exchange Service Command (2016). | 29 |

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

| | | |
|-----------|---|----|
| Table 1. | Joint camouflage uniform benefits..... | 42 |
| Table 2. | Individual uniform costs | 43 |
| Table 3. | Impediments to implementation. | 44 |
| Table 4. | NWU and MCCUU initial production quantities. Adapted from MCCUU Pre-Solicitation Conference Slideshow (2016). | 45 |
| Table 5. | Benefit performance..... | 47 |
| Table 6. | Weights and rationale | 48 |
| Table 7. | Assessment scores..... | 49 |
| Table 8. | COA impediments scale | 50 |
| Table 9. | Impediment weights and rationale | 51 |
| Table 10. | Impediment scores | 52 |
| Table 11. | Possible maximum and minimum benefit scores..... | 53 |
| Table 12. | Total unit costs. Adapted from Active Duty Military Strength (2018). | 55 |
| Table 13. | Benefit and cost summary..... | 57 |

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|--------------|---|
| ACE | Anchor, Constitution, Eagle |
| BDU | Battle Dress Uniform |
| C&T | Clothing and Textile |
| CADPAT | Canadian Disruptive Pattern |
| CBA | Cost Benefit Analysis |
| CBR | Chemical, Biological, Radiological |
| CCD | Camouflage, concealment, decoys |
| CONUS | Contiguous United States |
| CRS | Congressional Research Service |
| CUU | Camouflage Utility Uniform |
| DBDU | Desert Battle Dress Uniform |
| DCU | Desert Camouflage Uniform |
| DLA | Defense Logistics Agency |
| DoD | Department of Defense |
| EGA | Eagle, Globe, Anchor |
| ERDL | Engineer Research and Development Lab |
| FR | Flame resistant |
| FRV | Flame resistant variant |
| FY | Fiscal Year |
| GAO | Government Accountability Office |
| IFF | Identification friend or foe |
| IFRV | Improved flame resistant variant |
| MARCORSYSCOM | Marine Corps Systems Command |
| MARPAT | Marine Pattern |
| MCCUU | Marine Corps Combat Utility Uniform |
| NAVFAC | Naval Facility Engineering Command |
| NAVSUP | Naval Supply Systems Command |
| NCTRF | Navy Clothing Textile Research Facility |
| NDAA | National Defense Authorization Act |
| NECC | Navy Expeditionary Combat Command |

| | |
|-------------|--|
| NEXCOM | Navy Exchange Service Command |
| NSNE | Non-smoothing non-exponential |
| NSRDEC | Natick Soldier Research, Development & Engineering Center |
| NSW | Naval Special Warfare |
| NWU | Navy Working Uniform |
| OCONUS | Outside Contiguous United States |
| OG-107 | Olive Green Shade 107 |
| OMB | Office of Management and Budget |
| PM | Program Manager |
| PM ICE | Program Manager Infantry Combat Element |
| PM-SOF SSES | Program Manager Special Operations Forces Survival, Support, and Equipment Systems |
| RTD | Research Technology and Development |
| SEAL | Sea, Air, and Land |
| SYSCOM | Systems Command |
| TFU | Task Force Uniform |
| UPMG | Uniform Program Management Group |
| UPMO | Uniform Program Management Office |
| USA | United States Army |
| USCENTCOM | United States Central Command |

ACKNOWLEDGMENTS

We would like to recognize our advisors, colleagues, and mentors who helped us bring this project to life. To our advisors, Dr. Robert Mortlock and Dr. Spencer Brien, we thank you for your counsel and guidance in helping us create a product we are proud of.

Bryce would like to thank his team members Jason and Varsha, along with Jose Galvao and Tom Poe.

Jason would like to thank his project partners, Varsha Styer and Bryce Hicks, whose professionalism, dedication, and friendship made this work a positive and enriching experience. He would also like to thank his family, especially his wife, Jennifer, for all of her love and support. He dedicates his work to his children, Steven, Zayda, Zander, and Shaylee.

Varsha would like to express her heartfelt gratitude to her esteemed colleagues, Jason House and Bryce Hicks, for their commitment to this project. She thanks her husband, Shamaer, for his unwavering support and unconditional love. She would also like to thank her family for their endless love, support, and encouragement. She dedicates her work to her daughter: Kendall, thank you for being my biggest cheerleader.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. PROBLEM STATEMENT

The distinction between United States Armed Forces uniforms allows service members to immediately possess a strong sense of pride for their selected service. Separate, distinct uniforms also contribute to the uniqueness of each military branch of service and the respective roles each service plays in the defense of the United States of America. Additionally, officers and enlisted have different uniforms to ensure distinction between the different groups of service members. The Navy has a common uniform worn by all called the Navy Working Uniform (NWU) in three variants. The Marine Corps also has a common uniform that comes in two variants called the Marine Corps Combat Utility Uniform (MCCUU).

The Marine Corps administratively falls under the Department of the Navy, yet the Navy and Marine Corps each have their own sets of uniforms. The current method for uniform procurement is performed independently by each branch and over the last eighteen years, both services have fielded different combat uniforms to go along with the different utility and dress uniforms. The Fiscal Year 2014 National Defense Authorization Act, Section 352, calls for the elimination of the “development and fielding of Armed Force-specific combat and camouflage utility uniforms and families of uniforms in order to adopt and field a common combat and camouflage utility uniform or family of uniforms for specific combat environments to be used by all members of the Armed Forces” (National Defense Authorization Act [NDAA], 2014).

Organized under the Department of Defense, the Navy and Marine Corps are hierarchical organizations with numerous layers of command for oversight and control. Since 2002, the four branches of the American military “have introduced seven camouflage uniforms with varying patterns and colors” (Russell, 2012, p. 2). Russell (2012) goes on to say that the uniforms were not developed in coordination with each other to ensure similar “levels of performance and protection for service members” (p. 2). Today’s leaders cling to the value of having a unique uniform for each service branch, particularly the morale benefits

it brings. The road ahead will be difficult for the individual service chiefs to agree to switch to a common uniform. For example, the Joint Clothing and Textiles Governance Board did not meet in 2011 because the representatives from the Office of the Secretary of Defense, the Joint Staff, and all military services did not agree on criteria to evaluate the performance of camouflage uniforms (Russell, 2012). Congress' significant roadblock in the future efforts of services to have individual uniforms ensures an uphill path that will remain controversial because of the desires for individuality among service branches.

B. RESEARCH QUESTIONS

In order to achieve reduced costs for both Navy and Marine Corps for uniforms, the focus of this thesis will seek to identify increased benefits using a Cost-Benefit Analysis approach, while ensuring service members retain necessary protection in combat. The study will analyze benefits and costs, as well as identify impediments to implementing a single functional uniform for both Navy and Marine Corps use at Contiguous United States (CONUS) and Outside Contiguous United States (OCONUS) locations.

Primary Research Question: Are there benefits to consolidation of Navy and Marine Corps combat and working uniforms into a common functional uniform?

Secondary Research Question: What are the impediments and disadvantages for the Navy and Marine Corps to adopt a single functional uniform for service members?

C. PURPOSE

The purpose of this literature review is to perform analysis related to design, development, fielding and testing for Navy and Marine Corps camouflage uniforms. Specifically, examining the costs and benefits of consolidating the NWU Type II and Type III uniforms with the MCCUU into a single functional uniform for both branches. Moreover, the thesis will identify impediments to consolidation into a single functional uniform.

To maintain optimum functionality for the entire military, the GAO study found the Armed Forces spent “about \$300 million in Fiscal Year 2011 in the [procurement of] new camouflage uniforms” (Russell, 2012, p. 1). Russell further states that “each service

has introduced at least one new uniform into inventory in the last 10 years” (p. 4). In 2009, Congress restricted DoD spending via the introduction of Section 352 of Public Law 111–84, “the policy on ground combat and camouflage utility uniforms” (National Defense Authorization Act [NDAA], 2010). With growing legislative attention on spending of the limited and tightly controlled defense budget, Public Law 111–84 required “the Comptroller General to conduct a review of the ground combat uniforms and camouflage utility uniforms” presently use in the DoD (NDAA, 2010). Additionally, Solis (2010) adds the 2010 NDAA required the GAO to examine factors such as “performance, interoperability, costs and logistics, and patents or other proprietary elements involved in the services’ ground combat uniforms” (p. 4). In addition to Solis’ study, the Russell (2012) GAO study observed current uniforms from a cost perspective analyzing the design, development, fielding and testing of each uniform concept to the management of each service-specific uniform.

Russell (2012) questioned why the DoD has developed seven new individual service specific combat uniforms since 2002, despite operating in a fiscally constrained defense budget environment. The GAO was tasked with examination of the Office of Management and Budget (OMB) policies and DoD’s guidance on acquisition decision processes, key practices, statutory requirements and policies to ensure newly acquired camouflage uniforms met operational requirements. Additionally, the GAO studied the implementation of a joint camouflage uniform that provides adequate protection to the end user at a conservative cost (Russell, 2012).

The GAO found that each service followed a different acquisition approach “for managing their uniform development programs and did not consistently develop effective camouflage uniforms” in accordance with the DoD Directive 5000.01, Defense Acquisition System (Russell, 2012, p. 2). One of the functions of the Defense Acquisition System is for the DoD to apply investment strategies to support “not only today’s force, but also the next force and future forces beyond that” (Department of Defense [DoD], 2007). The DoD 5000 series (2007), also discusses management principles and additional policies that govern procedures for managing all acquisition programs such as “flexibility, responsiveness, innovation, discipline, streamlined and effective management,

collaboration, competition, cost and affordability, cost realism, cost sharing, interoperability” (p. 3).

D. ORGANIZATION

The thesis begins with a brief introduction, the purpose of the research, and introduces current Navy and Marine Corps functional uniforms. Chapter II goes into detail on the background and history of current Navy and Marine Corps uniforms. The focus of the study is on the functional uniforms worn in combat by the two services, but it also touches on the other uniforms previously and presently worn by Sailors and Marines to help portray the scope of number of uniforms. Chapter III contains a literature review of Congressional Research Service (CRS) reports, Government Accountability Office (GAO) reports, and relevant National Defense Authorization Acts (NDAA). Chapter IV describes the methodologies utilized, specifically the Cost Benefit Analysis, and discusses the results. Finally, Chapter V provides a summary, conclusions with answers to the research questions, and recommendations from the findings.

II. BACKGROUND

A. INTRODUCTION TO CAMOUFLAGE

The term “camouflage” came into great focus during World War I when air warfare and air reconnaissance became a source of military superiority (Imperial War Museum, 2018). Military forces in World War I were no longer able to easily remain unseen because military aircraft could now search and locate enemy forces from the air. Searching for the enemy via aircraft was substantially quicker than waiting for scouts to search and return, and it reduced the amount of required manpower to perform the same function. Since its inception, camouflage has been desired by military service members to reduce detection in a training or combat environment and to blend in to their surroundings. Due to the sustained importance of camouflage and the potential benefits it can generate when properly utilized, the United States Army (USA) developed a field manual that discusses camouflage, concealment, and decoys (CCD) (Department of the Army [DA], 2010). By definition, CCD is “the use of materials and techniques to hide, blend, disguise, decoy, or disrupt the appearance of military targets and/or their backgrounds. CCD helps prevent an enemy from detecting or identifying friendly troops, equipment, activities, or installations” (DA, 2010, p. 1–1). Uniforms quickly needed to have camouflage effects due to the emergence of air warfare. Today, efforts to camouflage personnel and equipment remains a significant area of focus for militaries around the world. Camouflage is utilized on items such as weapons, buildings, vehicles, personal gear, aircraft, as well as for personnel.

While camouflage was employed in World War I by United States ground forces, the focus of this research will discuss the history of uniforms worn by United States Marine Corps and United States Navy service members after World War II. The Second World War contributed to the determination that a single uniform worn in all combat environments was not the uniform solution, as evidenced by Solomon Island Operations (Suciu, 2015). The Marine Corps first large-scale utilization of camouflage uniforms was at Bougainville in November 1943, but the uniforms were soon determined to be ineffective during fighting at Tarawa due to vast differences in the colors and foliage of the

differing lands (Suciu, 2015). Figure 1 displays the Pattern 41 cotton-twill camouflage uniform worn during World War II.

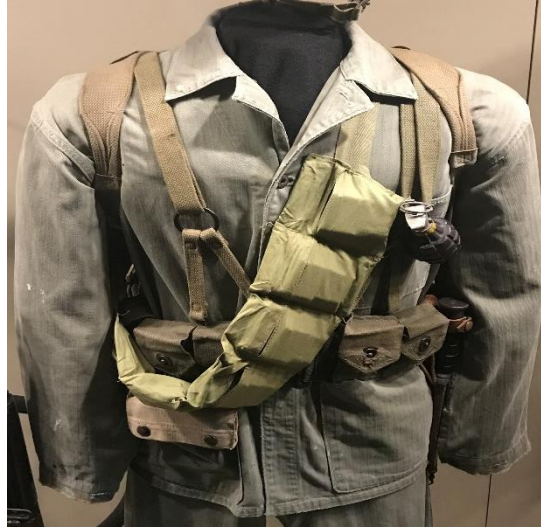


Photo taken at The National World War II Museum in New Orleans, LA.

Figure 1. Pattern 41 camouflage

Military uniforms cannot be discussed without identifying the United States Army as the lead for military uniforms worn by all services because of the sheer volume of Soldiers that wear combat uniforms and their importance to ground combat mission effectiveness. It is also important to understand that the camouflage uniform information focuses primarily on pattern differences due to the differing environments they are worn in and their intended function. With the advances in technology over the years, uniform fabrics have improved to accommodate lighter weight uniforms, better design functionality and improved performance in areas like fire retardants and insect repellency to support the warfighter in their assigned missions.

B. NON-SERVICE SPECIFIC CAMOUFLAGE UNIFORMS USED BY AMERICAN FORCES

Prior to 2002, the Army's Battle Dress and Desert Camouflage uniforms were worn by service members of the four military service branches and are discussed in this section (Russell, 2012). The uniforms were not service specific and the services did not seek out

unique patterns and color schemes to differentiate themselves. With the most ground forces, the Army assumed the lead on the design and adaptation of new uniforms for decades.

1. Olive Green Shade 107

The Olive Green Shade 107 (OG-107) uniform was first introduced by the United States Army for use by all Armed Forces in 1952 and remains one of the longest-running utilized uniforms that was worn by forces until 1989 (“Utilities/Jungle Fatigue, n.d.). Utilities/Jungle Fatigues (n.d.), goes on to mention that there were eventually three variations of the OG-107 uniform, but each one was made with the same army green dye. Furthermore, Utilities/Jungle Fatigues (n.d.), identified that the first variation of the jacket was made from 8.5-ounce cotton sateen and had exposed buttons on the four front-side pockets, but the exposed buttons placed the jacket at an increased risk for them to snag or catch on branches and other items in the environment. The button issue was subsequently corrected by having the second and third variations contain enclosed buttons. A similarity between the first and second variations is that each had shoulder loops, gas flaps, side adjustment tabs for better fit, and adjustable cuff sleeves that allowed service members the ability to roll their sleeves up depending on the weather and personal comfort. One similarity that remained between all three variations were four pockets on the front of the jacket, two of them being angled near the chest area and two bellow-style near the lower portion of material. Additionally, there were two modifications to the original OG-107 pants, with the primary change being enclosed buttons on the second and third variations, which reduced the likelihood of them catching on items (“Utilities/Jungle Fatigue, n.d.). Figure 2 displays one variation of the OG-107.



Figure 2. OG-107 camouflage. Source: “Utilities/Jungle Fatigue” (n.d.).

2. Tiger Stripe

The Tiger Stripe uniform was first utilized in 1965 during the Vietnam War and its predominant colors were black and green with a shade of khaki, which allowed it to blend in with the jungle environments of Vietnam (Durando, 2014). Durando (2014) state while the Tiger Stripe was not developed by the United States Army or for the American military, the stripe pattern uniform was unofficially used by special forces such as U.S. Navy SEALs, U.S. Army Green Berets, and other specialized forces along with certain South Vietnamese forces. The uniform has numerous print variations in the camouflage because it was concurrently produced in several Southeast Asian countries and some contracts had different patterns (Blechman, 2013). SEALs first came into existence in 1962 and within three years of their existence, they utilized different uniforms in combat than other Navy personnel, something that remains a constant today. U.S. Navy SEALs are an inherently combat-focused force that conducts unconventional warfare operations. Early on in their inception they wanted to distinguish themselves by wearing a camouflage uniform that they deemed as the best available for their operating environment. Figure 3 displays the Tiger Stripe camouflage pattern on the blouse with four front pockets. As shown, it depicts the continued use of enclosed buttons.



U.S. Army photo by Spc. 5 Thomas A Seddon Jr.

Figure 3. Tiger Stripe camouflage pattern. Source: Collins (n.d.).

3. Engineer Research and Development Lab

The Engineer Research and Development Lab (ERDL) camouflage uniform pattern shown in Figure 4, nicknamed the “leaf pattern” uniform, first came into American military use in 1967 (Durando, 2014). It consisted of shades of green, black, brown, and tan colors on cotton material. In order to provide camouflage protection for personnel it had shapes that resembled leaves, hence its nickname. The uniform blouse continued to have four front pockets and was first used in Vietnam. Moreover, it was worn approximately 15 years by American forces. While some elite forces wore the Tiger Stripe uniform in Vietnam, the ERDL uniform became the uniform for all other American forces. Furthermore, the uniform saw use in combat zones in Beirut, Grenada, and Iran.



Figure 4. ERDL camouflage pattern. Source: “Utilities/Jungle Fatigue” (n.d.).

4. Woodland Camouflage Utility Uniform

In 1981, the woodland Camouflage Utility Uniform (CUU) was introduced to American Armed Forces and became the official uniform for all services (Durando, 2014). The Navy referred to it as the CUU in their printed materials; however, the Army, Air Force, and Marine Corps called it the Battle Dress Uniform (BDU) and it was unofficially referred to as the M81 uniform (Durando, 2014). Two blends of material were produced. One in a 50 percent nylon and 50 percent cotton twill material blend, and the other on 100 percent cotton material. The CUU/BDU uniform was utilized by all services for at least two decades, with the Marine Corps wearing the uniform until 2006 and the Navy until 2012. Moreover, the uniform was very similar to the ERDL version because it had a similar pattern and the four-color scheme of green, black, brown, and tan. The major difference between the ERDL and CUU pattern was the size of the pattern, with the CUU having slightly larger camouflage patterns. The CUU continued to have four pockets on the front of the blouse, with the buttons on each pocket remaining concealed and not directly exposed to the environment. Figure 5 shows the woodland CUU blouse.



Figure 5. Woodland camouflage utility uniform pattern. Source: Double Tap Military Surplus (n.d.).

5. Desert Battle Dress Uniform

The Desert Battle Dress Uniform (DBDU) was developed by the U.S. Army in 1977 and officially introduced for wear by the Armed Forces in 1981, the same time as the CUU (Suciu, 2015; Durando, 2014). It was sometimes referred to as the “chocolate chip” uniform because of its resemblance to chocolate chip cookie dough (Durando, 2014). It displayed a six-color camouflage pattern consisting of black, white, green, and tan tones. Also, it gained significant attention during Operation Desert Storm in 1991; however, it did not blend in well with the environments in the Middle East and forced the services to re-think its continued use on the battlefields. The DBDU pattern is shown in Figure 6.



Figure 6. DBDU camouflage pattern. Adapted from Smithsonian National Museum of American History (n.d.).

6. Desert Camouflage Uniform

As a result of the review of the DBDU used in Operation Desert Storm, the services developed the Desert Camouflage Uniform (DCU) in 1993 (Suciu, 2015). It is shown in Figure 7 and was occasionally referred to as the “coffee stain” uniform. It consisted of a camouflage pattern of brown, green, and beige, which was a three-color pattern reduction from the DBDU. Its development was assisted by using soil samples from Saudi Arabia and Kuwait, and was widely utilized by the services beginning in the early 1990s (Suciu, 2015). This uniform saw combat action in Operation Enduring Freedom in 2001 and Operation Iraqi Freedom in 2003. Eventually, the Marine Corps began to phase this uniform out of use beginning in 2002 with its introduction of a Marine Corps specific uniform, and the Navy wore it until 2012 when it made a new uniform mandatory for its personnel.



Figure 7. DCU camouflage pattern. Source: CIA (2012).

C. USMC SPECIFIC UNIFORMS

The USMC has always been a distinctive component of the Department of Defense. The Marines are a Department within the Department of the Navy, and have worked closely with naval forces since their founding. In early 2000, the Marine Corps sought out a unique digital camouflage pattern to differentiate themselves, and became the first service to wear different uniforms in combat beginning with Operation Enduring Freedom and Operation Iraqi Freedom. Not only did the Marine Corps seek a “unique,” service-specific uniform, they sought one “to improve durability and combat utility” (Commandant of the Marine Corps, 2002).

1. Marine Corps Combat Utility Uniforms

The Marine Corps was the first service branch in the American military to design and wear camouflage uniforms for their exclusive use with the release of the Marine Corps Combat Utility Uniform (MCCUU) in the woodland and desert Marine Pattern (MARPAT) camouflage. These patterns are displayed in Figure 8, with the woodland color on the left and the desert color on the right. They were also the first American military uniform to have a digital camouflage pattern in their material and the material is 50 percent nylon and 50 percent cotton (Sanborn, 2015). The USMC patterns are very similar to the Canadian

Disruptive Pattern (CADPAT), which Canada gave the Marines permission to evaluate for possible adaptation of a similar design. The initial transition from the woodland BDU and DCU to the woodland and desert MCCUU began in June 2002, with a deadline of 30 September 2006 being the last date to wear the BDU (Commandant of the Marine Corps, 2002). The MCCUU material has received permanent press treatment to eliminate the requirement for commercial pressing and starching, but it does not possess flame resistant (FR) qualities (Commandant of the Marine Corps, 2002). Additionally, the MCCUU has received permethrin treatment. When treated, the pesticide permethrin becomes a part of the camouflage fabric to kill or repel insects, to include mosquitos and ticks, and protect service members from diseases carried by insects (“Permethrin Treated Clothing,” 2017). Also, the MCCUUs have two front pockets on their blouse, a reduction of the two bellow-style pockets, and one pocket on each sleeve. The sleeve pockets were an addition to the uniform to enable the Marine to have the ability to grab small items such as a compass, maps, field books, and personal items when body armor is worn and covering the chest pockets (U.S. Patent No. 6805957, 2004). Additionally, in another design change to signify a difference between service uniforms, the two remaining chest pockets were slanted inward and contain Velcro closures instead of the normal buttons. The elbow sleeves, knee areas, and seat area contain extra material in order to facilitate a greater use of the uniform by providing reinforcement for the three highly abrasive areas on the uniform (U.S. Patent No. 6805957, 2004). To further cement their ability to deter other services from wearing their uniform, the USMC placed a patent on their digital camouflage color scheme, uniform design, and pattern, which includes the Eagle, Globe, and Anchor (EGA) emblem throughout the camouflage pattern (Solis, 2010). The uniforms also have an embroidered EGA on their left chest pocket. In addition to Marines wearing the MCCUU, all Sailors assigned to Marine Corps units are able to wear the MCCUU uniform, but the service tape above the left chest pocket of the blouse will state “U.S. Navy” instead of “U.S. Marines.”



Photo illustration by Lance Cpl. Michelle Mattei.

Figure 8. Woodland and desert MCCUU patterns.
Source: Marine Corps Base Camp Pendleton (2008).

2. Flame Resistant Marine Corps Combat Utility Uniforms

In 2017, the Marine Corps introduced a flame resistant variant of the MCCUU (Browne, 2016). Browne (2016) also stated that the variant is available in a long-sleeve shirt and trousers, and comes in the woodland and desert patterns. Instead of Marines receiving four sets per deployment, they are issued two sets of the flame resistant variant, without a decrease in comfort or protection for the individual Marine (Browne, 2016). The flame resistant variant provides increased protection in the event they are burned while maintaining camouflage concealment and the material contains three fibers, nylon, cotton, and meta-aramid, to produce “a material highly resistant to high temperatures, chemical degradation and abrasion” (Browne, 2016, para. 4).

3. Future Tropical Uniform

The Marine Corps recently completed final user evaluations for a tropical uniform in September 2017 and the current woodland camouflage pattern is expected to remain (Randolph, 2017). The new fabric consists of an approximately 30 percent lighter-weight nylon and cotton blend than the current MCCUU in an effort to allow Marines to dry faster

and keep cooler in warm climates (Randolph, 2017). Moreover, the elbow, knee, and groin areas currently possess reinforced fabric in order to provide increased protection from mountainous terrain and vegetation typically found in tropical environments (Randolph, 2017). Figure 9 displays a potential tropical uniform design.

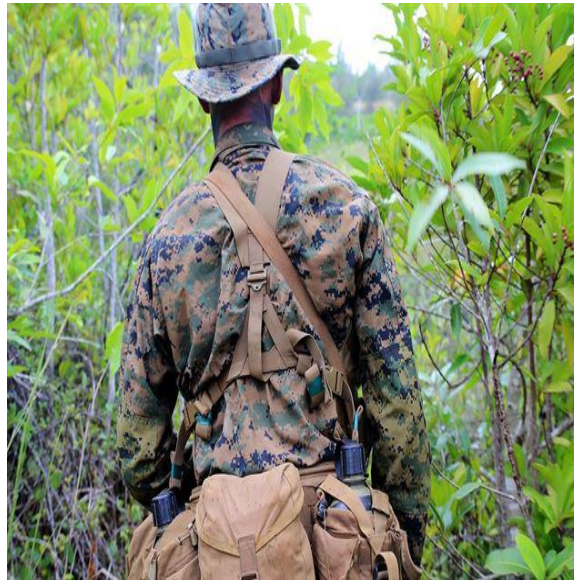


Figure 9. Possible MCCUU tropical uniform pattern. Source: Marine Corps Systems Command (2017).

D. USN SPECIFIC UNIFORMS

The USN operates on many different platforms and requires numerous uniforms depending on the specific community within the service. Ranging from sailors on ships in the surface community to SEALs in the special warfare community operating in the sea, air, and land, the Navy always has a plethora of uniforms for a variety of situations to fit its broad mission sets. The predominantly blue digital camouflage uniform, shown in Figure 10, was implemented as a replacement uniform because multi-colored uniforms do a better job of hiding wrinkles and reduce the showing of heavily worn areas (Task Force Uniform Public Affairs, 2012).

1. Navy Working Uniform Type I

In direct response to the USMC development of a service-specific uniform, the USN began development of a unique uniform for its personnel to reflect the “requirements of a 21st century Navy and its naval heritage” (Russell, 2012, p. 29). Additionally, the Navy sought to increase the morale of its personnel and assist in recruiting with the design of its first service-specific uniform in the Navy Working Uniform (NWU) Type I, something each service mirrored after the Marine Corps with its introduction of the MCCUU (Russell, 2012). The NWU Type I uniform is commonly referred to as “aquaflage” or “blueberries” due to the digital camouflage pattern being primarily navy blue with deck gray, haze gray, and black colors. The NWU Type I had an initial rollout date of December 2008 and a mandatory wear date of December 2010, and was designed to replace six uniforms: working utilities, tropical working uniforms, wash khakis, winter working blues, aviation working greens, and non-tactical usage of CUUs (Chief of Naval Operations, 2008). Its material consists of a 50/50 nylon and cotton twill fabric material. In another effort to mimic the MCCUU, the Navy placed an Anchor, Constitution, and Eagle (ACE) emblem throughout its camouflage uniform fabric, and below each ACE emblem are the letters “USN.” It also possesses an embroidered ACE emblem on the front left blouse pocket. Similar to the MCCUU, the NWU Type I possesses additional material around the seat, knee, elbow areas, has two front chest pockets with enclosed buttons, and two pockets on the shoulders. At no time was the uniform meant to be worn in a ground combat environment or provide camouflage protection on a ship at sea; it was developed to be the standard working uniform ashore when special clothing was not required, such as on flight decks and in engineering machinery spaces (Chief of Naval Operations, 2008). Following Navy leadership guidance from 1996 of FR qualities not being required in navy working uniforms, the uniform was developed without FR qualities (United States Fleet Forces, 2012). Following a test by the Navy Clothing Textile Research Facility (NCTRF) in October 2012, it was discovered that the uniform would burn until consumed and became a controversial safety topic. Shortly after the test, the NWU Type I was no longer an acceptable uniform for wear while underway on a vessel, and it has a final date of wear of 30 September 2019. Figure 10 shows the NWU Type I camouflage pattern.



Figure 10. NWU Type I camouflage pattern.

2. Navy Working Uniform Type II

The NWU Type II was fielded in February 2011 and became a mandatory replacement for the DCU in June 2012 for Naval Special Warfare (NSW) personnel (Russell, 2012; Chief of Naval Operations, 2011). Its material consists of 50 percent nylon and 50 percent cotton ripstop. Naval Special Warfare Command, operating under the direction and authority from United States Special Operations Command, had the lead in the design and testing efforts. This is a change because other uniforms are not developed by a specific community or organization such as the NCTRF. As such, the uniform is not available for purchase in Navy Exchange retail stores and is considered organizational clothing. The uniforms are only issued to NSW personnel and assigned personnel directly supporting their missions. Furthermore, the uniform is predominantly worn in “desert, tundra, and arid combat regions” (About NWU, n.d.). The NWU Type II uniform has two chest pockets, each with tapered flaps that contain a combination of buttons and Velcro that secure the pocket along with two small shoulder pockets. One difference between the NWU Type I and II is that the NWU Type II uniform has a Velcro patch on each shoulder pocket flap to allow identification friend or foe (IFF) markers to be placed there. Personnel can wear the reverse American flag on the right side and the “Don’t Tread on Me” patch

on the left shoulder. Another difference is the location of the rank. On the NWU Type I, rank is worn on both collars, but the NWU Type II rank is displayed on a single center chest Velcro tab. There is not a place for wear of a staff corps insignia because those devices are not necessary requirements for the tactical performance of the uniform, and a center rank Velcro tab allows the service member to wear the uniform collar in the up position when body armor and Chemical Biological and Radiological (CBR) gear is used (NWU Q & A, n.d.). Another difference is the angle of the cargo pockets on the trousers. The NWU Type II has canted pockets to allow easier ergonomic access when personnel are in a seated position in a tactical vehicle, chest pockets with hidden buttons and Velcro, calf pockets, and two pockets on the shoulders (NWU Q & A, n.d.). Finally, the NWU Type II does not possess FR qualities. It also does not have the embroidered ACE emblem on the left chest pocket as the NWU Type I does, but it does have the ACE emblem in the digital camouflage print throughout the uniform fabric. Figure 11 shows the NWU Type II camouflage pattern.



Figure 11. NWU Type II camouflage pattern. Adapted from Navy Personnel Command (n.d.).

3. Navy Working Uniform Type III

The NWU Type III was fielded in September 2011 and originally issued as organizational clothing to a specific list of NSW and expeditionary commands (Russell, 2012). Initially, it was a replacement for the woodland CUU and the NWU Type III could not be purchased by individuals, but had to be procured by Logistics Specialists using a National Stock Number. Unauthorized requestors would have their requisition cancelled if they were not one of the authorized commands. It became an authorized uniform for daily wear for all Navy personnel, excluding Marines, in October 2016 and is sometimes referred to as “guacamoles” (Chief of Naval Operations, 2017). CNO (2017) declares it will officially replace the NWU Type I as the daily working uniform on 1 October 2019. It is intended to be worn ashore, in port, when special clothing is not required to be worn in a particular environment or space, and at sea for special events when authorized by the Commanding Officer (Chief of Naval Operations, 2017). Furthermore, the NWU Type III was “designed for woodland, jungle, and temperate regions” (About NWU, n.d.). In addition to Navy personnel wearing the uniform, select members of the United States Coast Guard are allowed to wear the NWU Type II and III, and they have the “U.S. COAST GUARD” service tape above their left chest pocket instead of “U.S. NAVY.” The number of pockets, pocket locations, trouser pocket angles and placement, along with Velcro and button placement, are all located and designed the same as the NWU Type II. On the NWU Type III uniform, the Chaplain Staff Corps is authorized to sew their insignia above the Velcro rank tab (Chief of Naval Operations, 2017). The NWU Type III consists of the material blend of 50 percent nylon and 50 percent cotton ripstop, and like the NWU Type II, it was not developed with FR qualities. Like the NWU Type II, the NWU Type III does not have the ACE emblem embroidered on the left chest pocket, but the NWU Type III material is commonly accepted to be lighter and breathe easier than the NWU Type I. All three versions of the NWU are not flame resistant and have not received the permethrin treatment (Solis, 2010). Figure 12 shows the NWU Type III camouflage pattern.



Figure 12. NWU Type III camouflage pattern

4. Flame Resistant Navy Working Uniforms

As previously mentioned, the Marine Corps delivered a MCCUU flame resistant variant to its Marines in 2017 (Browne, 2016). While the Marine Corps Systems Command led the market research efforts, they partnered with Navy Supply Systems Command for an NWU Type II and NWU Type III variant to be flame resistant for Navy expeditionary forces (Browne, 2016). The material fibers are the same as in the MCCUU variant, consisting of nylon, cotton, and meta-aramid (Browne, 2016).

5. Flame Resistant Variant Coveralls and Flight Suits

There are two types of Flame Resistant Variant (FRV) coveralls. After the aforementioned flame testing on the NWU Type I, the initial FR variant uniform was rapidly introduced to the Navy in October 2013 (United States Fleet Forces, 2013). The uniform was produced from a flame retardant treated 100 percent cotton fabric and was designed to be worn by all afloat sailors, beginning with the stationing of the sea and anchor detail to the return pier side (United States Fleet Forces, 2013). Also, Commanding Officers retain discretion to allow the FRV coveralls to be worn in port (United States Fleet Forces, 2013). No purchase is necessary by individual sailors because the uniforms are issued as organizational clothing and are procured by Logistics Specialists using National

Stock Numbers. The original FRV coverall had durability and comfort concerns, with holes quickly forming near the ankles after a short duration of wear and torn material throughout the uniform, forcing re-engagement on a new variation (United States Fleet Forces, 2017). The second variation of the FRV coverall, the Improved Flame Resistant Variant (IFRV) coverall, is the replacement for the FRV and is shown in Figure 13 (United States Fleet Forces, 2017). Its development began in 2015 with United States Fleet Forces and NCTRF taking the lead for design and testing. They are currently being phased into wear in Fiscal Year 2018 and are produced with a tri-fiber blend of flame resistant fabric. The tri-fiber blend uses tecasafe plus (modacrylic/aramid/lyocell) and protera (modacrylic/aramid/antistat) fabrics, each containing three materials to form the tri-fiber blend (E. Hamalian, email to author, April 25, 2018). According to a wear test of over 700 sailors, 91 percent determined the IFRV to be more comfortable and 86 percent felt it was more durable (United States Fleet Forces, 2017). While the FRV and IFRVs are not camouflage or combat uniforms, they can instantly be considered a combat uniform by Navy personnel if the ship comes under attack and the ship personnel go to fight and protect the ship at their assigned battle stations, as evidenced by sailors on the USS *Mason*, USS *Nitze*, USS *Ponce*, and USS *San Antonio*. Sailors on those ships came under direct attack when Houthi rebels ashore in Yemen targeted their ship with cruise missiles, forcing the vessels to respond. Additionally, naval aviation personnel wear flight suits that do not possess camouflage or digital camouflage patterns, yet they routinely are some of the first individuals to enter a combat zone. Figure 14 displays a green Navy flight suit. While the FRV and IFRV coveralls come in one navy blue color and are not meant to provide camouflage protection, flight suits are available in two versions, green and khaki, and the color is selected depending upon the operating environment. Typically, the green flight suit is worn by aviation personnel unless they are flying missions in the United States Central Command (CENTCOM) area of responsibility.



Figure 13. IFRV coverall. Source: Virginian Pilot (2017).



Figure 14. Navy flight suit

E. CAMOUFLAGE IN MAJOR LEAGUE BASEBALL

While the MCCUU has the EGA emblem throughout their MARPAT pattern, they have allowed the San Diego Padres to use their pattern and colors, without EGA emblem. Also, the camouflage jersey sold to the public does not contain the EGA. The EGA emblem

is a distinguishing feature embedded in their pattern, but they do not have an issue lending the pattern for use to a non-military entity. If the EGA can be removed and worn by others, the question as to why the U.S. Navy or other services cannot utilize their design comes to mind.

Since 2000, the San Diego Padres have been wearing camouflage jerseys for Sunday home games, military Opening Days, and for other special occasions (Center, 2011). San Diego is home to a large military population with Sailors and Marines stationed at numerous basis throughout the surrounding area. Sailors are stationed at duty stations in the area to include Naval Air Station North Island, Naval Base San Diego, Naval Amphibious Base Coronado, while Marines are represented at Marine Corps Recruit Depot San Diego, Marine Corps Air Station Miramar, and Camp Pendleton.

The first camouflage uniform pattern jersey worn by the Padres was the Army's woodland BDU pattern and it was worn for six seasons from 2000–2005. In 2006, the Padres switched camouflage pattern designs to the DCU through the 2010 season, and in 2011, they switched to the desert MCCUU. The fourth camouflage pattern used by the Padres, the NWU Type I digital pattern, was introduced for the 2016 season, but the 2017 season saw the re-introduction of the desert MCCUU. Of note, both the digital camouflage MCCUU and NWU Type I patterns were approved for the Padres use by the Marines Corps Commandant and the Navy's Chief of Naval Operations (Center, 2011; "Padres Unveil," 2015). Additionally, the Cincinnati Reds and Pittsburgh Pirates wore the desert MCCUU pattern on alternate jerseys during the 2017 season. Moreover, camouflage patterns have appeared on socks and caps for wear during games, and the camouflage apparel partnerships between Major League Baseball and companies such as New Era, Majestic, and Stance appear to be a constant for the foreseeable future due to the marketability of the items. Figure 15 displays the 2018 Padres desert digital camouflage alternate jersey available for purchase.



Figure 15. 2018 San Diego Padres MCCUU desert pattern camouflage alternate jersey. Source: Major League Baseball Shop (2018).

F. SUMMARY

There have been numerous uniforms worn by the Navy and Marine Corps services throughout the course of their examined history and they are listed in Figure 16. Each new uniform is designed to provide increased protection and functionality when compared to the uniform it is replacing. Examples include upgrades in uniform materials such as flame resistant fibers and functionality of the pockets and button placement, along with permethrin treated material. Each addition is incorporated to provide increased benefits and protection to the service members. In the following chapter, an examination of key stakeholders in the design and testing of uniforms will be performed. The following chapter will also provide greater discussion on relevant GAO reports, CRS reports, and NDAAAs.



The USMC tropical uniform has not been approved for wear and is not included. Additionally, the current USN flight suit is not included due to limited discussion in the thesis.

Adapted from Commandant of the Marine Corps (2002), Chief of Naval Operations (2008), Chief of Naval Operations (2011), Russell (2012), United States Fleet Forces (2013), Durando (2014), Suci (2015), Browne (2016), United States Fleet Forces (2017), and “Utilities/Jungle Fatigue” (n.d.)

Figure 16. 1952–Present timeline of Navy and Marine Corps uniforms.

III. LITERATURE REVIEW

A. BACKGROUND

In recent years Congress has taken a keen interest in the defense budget, specifically the costs related to the acquisition, development, production and procurement of new ground combat uniforms for each branch of the military. Although there are zero academic reviews on this topic, the issue of camouflage pattern copyright battles and newly developed combat uniforms is a widely debated subject across the Department of Defense (DoD) and Congress (Russell, 2012). Reviews of available literature are occurring through military publications, forums, Government Accountability Officer (GAO) reports, Congressional Research Service (CRS) reports, National Defense Authorization Act (NDAA) information and additional Department of Defense (DoD) directives regarding the introduction of new combat uniforms. The challenge Services face rests in finding the balance between reasonable funding toward design, development, fielding and testing of each new uniform while managing the risks encountered by end users. Additionally, GAO reviews include discussion on factors such as “performance, interoperability, costs and logistics, and patents or other proprietary elements involved in the services’ ground combat uniforms” (Solis, 2010, p. 4).

The following section discusses key stakeholders involved in the design, development, testing, procuring, and fielding of a new uniform in the Navy and Marine Corps. In that section, we briefly examine the relationship between the Navy Exchange Service Command (NEXCOM), Marine Corps Systems Command (MARCORSSYSCOM), Naval Facility Engineering Command (NAVFAC), U.S. Army Natick Soldier Research, Development & Engineering Center (NSRDEC), along with Defense Logistics Agency (DLA) Troop Support Clothing and Textiles. This thesis project describes how they all work together to produce the combat uniforms for the United States Navy and Marine Corps.

1. Navy Exchange Service Command (NEXCOM)

The Navy Exchange Service Command (NEXCOM) falls under the Naval Supply Systems Command (NAVSUP) and is an Echelon III command. Under NEXCOM's Uniforms Program division, seen in Figure 17, there are three uniform program offices reporting to the Deputy Commander of Uniform Programs at NEXCOM (NAVSUP, 2016). The three offices include Uniform Products Management Group (UPMG), the Uniform Program Management Office (UPMO), and the Navy Clothing and Textiles Research Facility (NCTRF). The UPMO acts as the uniforms program managers (PM) while the UPMG is responsible for the implementation of the Navy uniform program, which includes introducing uniform policies, process and guidance on how to improve uniforms functionality, and new uniform development (NEXCOM, n.d.a.). NCTRF, which is co-located with NSRDEC in Natick, Massachusetts, is comprised of four laboratories: Textile Performance Lab, Flame and Thermal Lab, Biophysical Lab, and Pattern and Prototype Lab. The laboratories core functions include testing fabrics for conformance to fire and heat resistance standards, water immersion and buoyancy testing, heat and cold stress, and ballistic protection. Furthermore, its other primary focus is uniform design and development. NCTRF is distinguished as one of the expert laboratories in garment and textile testing for the military because of its knowledgeable team of textile and its involvement in the fabric research, technology, and development (RTD) (NEXCOM, n.d.b.).



Figure 17. NEXCOM Uniform Program Division Organizational Chart.
Adapted from Navy Exchange Service Command (2016).

2. Marine Corps Systems Command (MARCORSYSCOM)

Marine Corps System Command, also known as MARCORSYSCOM, serves in a dual capacity role as a Naval Systems Command (SYSCOM) and a Headquarters Marine Corps Organization (Marine Corps Systems Command, n.d.). MARCORSYSCOM functions as the lead contracting and procurement authority for the Marine Corps and is responsible for the Marine Corps core acquisition processes (Marine Corps Systems Command, n.d.). The MARCORSYSCOM portfolio is comprised of six areas, each having its own program managers. Clothing and equipment is handled by Program Manager Infantry Combat Equipment (PM ICE), who is responsible for “developing, fielding, and sustaining infantry combat equipment to enhance the performance, capability, survivability, and mobility of Marines” (PM ICE, n.d.).

3. Naval Facility Engineering Command (NAVFAC)

NAVFAC manages all facets related to the building and sustainment of naval facilities, which includes installation services as well as the acquisition and management of expeditionary forces. As an expeditionary systems command capacity, NAVFAC provides the initial furnishing and life-cycle management of the systems, equipment and material authorized in the expeditionary field related to organizational clothing for Navy Expeditionary Combat Command (NECC), naval beach forces and similar forces (NAVFAC, n.d.). The Chief of Naval Operations (CNO) assigned NAVFAC as the Program Manager (PM) and Technical Authority for the NWU Type II and NWU Type III (Chief of Naval Operations, 2011). CNO (2011) goes on to say NAVFAC receive support from Naval Special Warfare Command, Program Manager–Special Operations Forces Survival, Support, and Equipment Systems (PM-SOF SSES), and U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC).

4. U.S. Army Natick Soldier Research, Development & Engineering Center (NSRDEC)

The U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) is located at the U.S. Army Natick Soldier Systems Center in Natick, Massachusetts, under the Army’s Research, Development and Engineering Command.

NSRDECs purpose is to develop and test all facets of new material systems for U.S. Army soldiers (United States Army, 2017).

5. Defense Logistics Agency (DLA) Troop Support Clothing and Textiles

As an agency of the DoD, Grasso (2014), describes that “DLA is DoD’s largest combat support agency” (p. 2). The Clothing and Textiles (C&T) branch at DLA offers an expansive reach as it single-handedly leads the procurement of more than 8,000 items to include uniforms, footwear, and undergarments and manages more than 50,000 line items (“DLA Troop Support and Textiles,” 2017).

Located in Philadelphia, PA, C&T “coordinates and performs the procurement, management, and supply of the DoD clothing and textiles materiel on a DoD-wide basis” (Department of Defense [DoD], 2017, p. 4). Once a uniform design is approved and tested, C&Ts role is to procure, manage, store, and supply the uniforms to the military branches. Grasso’s (2014) report emphasizes that C&Ts specialists manage access to military uniform procurement through competitive contracts and may separately procure approved fabrics autonomously from textile industry and provide approve contractors.

B. UNIFORM FINDINGS

The wearing of a uniform symbolizes unity, camaraderie and a shared identity. It develops a strong sense of pride and professionalism. Within each branch of the Armed Forces, each particular group of people has a large sense of belonging. The concept of a consolidated camouflage uniform would foster stronger alliances and increased collaboration among members of the Armed Forces through the link they share identifying as a unified force. Looking at the Navy’s implementation of the NWU Type II and NWU Type III uniforms from a fleet-wide perspective, Faram (2017) adds “it was great that the rest of the force was adopting this uniform” (para. 6).

1. Marine Corps Combat Utility Uniform

In 2000, MARCORSYSCOM was tasked by the Commandant of the Marine Corps to develop a uniform that would provide Marines with more durability and combat utility options compared to the existing BDU uniform. The Commandant called for a unique

pattern that would provide commanders with versatility for different missions while becoming specific to the Marine Corps. In 2001, MARCORSYSCOM approved the camouflage Marine pattern (MARPAT) for production as the new MCCUU uniform. In 2002, the Marines developed and fielded the MCCUU desert and woodland MARPAT. Finally, by 2006 the MCCUU became the mandatory combat uniform for all Marines.

The Marines were praised by the GAO for their development of strategic documents to use as tools in aiding their acquisition planning and decision-making processes (Russell, 2012). In accordance with the DoD 5000 series (2007) acquisition guidance, the Marine Corps strategy highlighted deficiencies, considered modifying a current uniform, buying commercially available uniforms, and examined risks to cost, schedule and performance. The results of using these elements enabled the MCCUU uniform to be more cost effective at final design and development cost totaling to \$319,000 over nine years, but had higher expenditures in the production, procurement, distribution and storage of its combat uniform (Russell, 2012). GAO identified two critical features that are necessary in the uniform acquisitions process: 1) having detailed policies in place and ensuring procedures are upheld by each service, and 2) accessibility to powerful “information to make decisions, such as credible, reliable, and timely data” (Russell, 2012, p. 2). GAO 2010 and 2012 reports indicate that in comparison to the Navy and the other services, the Marine Corps was the only service to perform the two key functions that enabled them to achieve a successful outcome and develop a uniform that met its requirement (Solis, 2010; Russell, 2012). Russell (2012) also notes that the Marine Corps risk assessment of the MCCUUs was determined to have a 20-year life cycle (p. 14). The MCCUU was able to meet the requirements of providing optimal protection to include permethrin treatment, appearance, functionality, durability, fit and comfort to the end user. At the time of its development, the MCCUU was proven to meet the end user’s needs as well as the mission requirements through “a knowledge-based approach that includes obtaining sufficient information about technology, design options, and production capabilities so that the product will be able to meet various requirements” (Russell, 2012, p. 15).

Russell (2012) adds that the Marine Corps examined and tested approximately 70 camouflage patterns and later narrowed its final two options to the Tiger Stripe and an adaptation of Canada's Canadian Disruptive Pattern (CADPAT). During the rigorous field testing phase, the Tiger Stripe pattern could not be used because it did not provide a complete camouflage solution. Ultimately, the CADPAT variation was adopted and later became known as the MARPAT for the Marine Corps (Russell, 2012). Brown (2013) concurs "Military combat uniforms have two purposes: to camouflage soldiers and to hold together in rugged conditions." Aside from the camouflage pattern, Brown (2013) asserts "[i]t stands to reason that there's only one 'best' pattern, and one best stitching and manufacturer. It should follow that when such uniform is developed, the entire military should transition to it." His statement is parallel to the idea of having multiple camouflage uniforms in circulation, and the continuous development of more and more uniforms by individual services.

Section 352 of P.L. 113–66 NDAA (2014) repealed NDAA (2010) by creating a "revised policy on ground combat and camouflage utility uniforms." The new policy states that the

Secretary of Defense shall eliminate the development and fielding of Armed Force-specific combat and camouflage utility uniform and families of uniforms in order to adopt and field a common combat and camouflage utility uniform or family of uniforms ... it must be used by all members of the Armed Forces ... [after October 1, 2018] all services are prohibited from adopt[ing] any new camouflage pattern design fabric for any combat or camouflage uniform or family of uniforms for use by an Armed Forces unless the new design or fabric is a combat or camouflage uniform that will be [used] by all [branches] of the Armed Forces ... or one branch adopts a uniform already in use by another branch; or the Secretary of Defense grants an exception based on unique circumstances or operational requirements. (NDAA, 2014)

The Secretary of the Navy and Commandant of the Marine Corps are forbidden from developing or fielding "any new camouflage pattern design or uniform fabric for any combat or camouflage utility uniform or family of uniforms" (NDAA, 2014). Furthermore, the NDAA (2014) points out the limitation such as "the [s]ecretary of a military department

may not prevent the [s]ecretary of another military branch from authorizing the use of any combat or camouflage utility uniform or family of uniforms.”

The GAO study addressed two legal impediments preventing the Navy and Marine Corps from wearing each other’s uniform. The first argument the Marines made was that other services were not allowed to adopt the MARPAT design. Marines consider the MARPAT design to be intellectual property “using government-owned patents to prevent other services from using the MCCUU colors scheme, design and pattern” (Solis, 2010, p. 5). In its second argument, the Marine Corps claims “10 U.S.C. 771 prohibits a member of one service from wearing the uniform or distinctive part of the uniform ... belonging to another service” (Solis, 2010, p. 11). However, the Navy and Marine Corps jointly hold the patents for the MCCUU color scheme, design and pattern. Therefore, it is not a legal barrier and does not restrict the Navy and Marine Corps from designing or wearing a common uniform. In this way, it is easier for the Navy to use the MCCUU color scheme, design and pattern as no patent laws are infringed upon.

2. Navy Working Uniform (NWU) Type I

Unlike the Marine Corps, the Navy has recently come under scrutiny regarding the rapid introduction of three working uniforms. The NWU Type I was approved in 2003 and designed under the administrative concept by a Task Force Uniform (TFU) Charter from the Chief of Naval Operations (CNO). The NWU designed was influenced by a fleet-wide uniform survey where Sailors expressed their concerns to look like other war fighters and wear a camouflage pattern working uniform. The NWU Type I incorporated a blue and gray color camouflage. Additionally, “Task Force Uniform Public Affairs” (2005) stated that “more than 40,000 Sailors who took part in the fleet-wide survey claimed that the current NWU were not practical for the Navy working environment, are too costly and difficult to maintain, and do not reflect a professional military appearance” (para.3).

NCTRF was responsible for designing, developing and testing of various fabric types for the NWU. Due to the intended operating environments, the NWU design and development model did not include flame resistant or permethrin treated fabric, as the Marines possessed. The design characteristics addressed during the fabric development and

testing of the uniforms included the professional appearance, fit and comfort, safety to the Sailors, utility and durability through wear and laundering, ease of care, as well as storage and cost (Russell, 2012). In July 2010, the NWU Type I became the mandatory working uniform in the fleet. However, shortly after its introduction to the fleet, the NWU Type I was found to be highly flammable and inadequate of providing ample protection to sailors, which implied that the NWU Type I was not developed in accordance with DoD Directive 5000.01. Russell (2012) adds the Navy did not maintain a total systems approach for total life-cycle system management, optimal performance, operational effectiveness and suitability, survivability, safety, and affordability (Russell, 2012). Additionally, Solis (2011) reported on issues surrounding the supply and accessibility of flame resistance fibers related to the production of military uniforms. Solis (2011) claimed the Berry Amendment made FR fibers difficult in procuring because it prevented the DoD in purchasing certain items when not manufactured or produced in the United States. However, Section 829 of the Fiscal Year 2008 NDAA included the Ike Skelton Clause, which extended the “authority to procure fire resistant rayon fiber for the production of uniforms from certain foreign countries” from 2013 to 2015 (Solis, 2011, p. 17).

3. Navy Working Uniform (NWU) Type II and Type III

In 2006, during a review of Navy uniforms, CNO Admiral Michael Mullen announced approval of a concept for a new NWU Type II and NWU Type III camouflage pattern for Navy ground forces. The NWU Type II was restricted to the Navy Special Warfare community and its support personnel, and the NWU Type III was reserved for other ground forces supporting the deployed mission (About NWU, n.d.). By 2009, CNO Admiral Gary Roughead received approval from Special Operations Command (SOCOM) to use its camouflage patterns for the NWU Type II and NWU Type III uniforms (Russell, 2012). Initially in 2003, the decision to consolidate uniforms started as an effort to streamline seabag requirements by reviewing current uniforms. The nixing of the NWU Type I is another seabag slimming effort, and “[t]he transition from the NWU Type I to the NWU Type III will eliminate one of the Navy’s three camouflage patterns and ultimately improve uniformity among the force” (Faram, 2017). At the time of the FY14 NDAA, the Navy chose to transition to the NWU Type II because the pattern was already

developed. Russell (2012) contends Naval Special Warfare Command (NSWC) spent approximately \$8 million to develop its Personal Signature Management program and final draft design costs were \$435,000 for the NWU Type II and NWU Type III, which resulted in a combined total of \$8,386,000. That price total exceeded the combined design, development, distribution and storage cost of the MCCUU. NAVFAC oversaw the final designs of the two camouflage uniforms and soon after transferred program management responsibilities for the NWU Type II and Type III to NAVSUP (“Navy Working Uniform Program Transferred to NAVSUP,” 2014). In essence, the Navy spent \$8,386,000 on two NWU uniforms without flame-resistant or permethrin treated benefits. By February 2011, the Navy began fielding the NWU Type II and NWU Type III uniforms in September 2011 (Russell, 2012).

In summary, the NDAA’s requirement for a joint combat uniform development is a viable collaborative option for the U.S. Navy and the U.S. Marine Corps. The GAO studies conducted by Solis (2010) and Russell (2012) revealed the DoD’s fragmented approach in combat uniform development are ineffective when the services do not share patent information, collaborate, or apply the acquisitions strategies. The policies and procedures set forth in the DoD 5000 series (2007) function as tools to provide guidance in the acquisition decision making process. Finally, the United States is not the only country attempting to consolidate multiple armed forces uniforms by implementing a joint combat uniform. In 2017, O’Dwyer (2017) identified that the Armed Forces of Finland, Sweden, Norway, and Denmark collaborated to enter a \$500 million common uniform procurement program. O’Dwyer (2017) further states that “[c]ost and value were the primary factors driving collaboration” in the European defense deal. Uniform collaboration is occurring amongst other countries, and careful consideration should be given by Navy and Marine Corps leadership.

IV. METHODOLOGY

A. COST BENEFIT ANALYSIS MODEL

In his book *Utilitarianism* (1863), John Stuart Mill asserts what he calls the Happiness Principle, which holds that, “actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness. By happiness is intended pleasure, and the absence of pain; by unhappiness, pain, and the privation of pleasure” (Mill, p. 17). John Stuart Mill writes about happiness from a utilitarian perspective and does not refer to the individual happiness of a particular agent, but rather to the happiness of all those that are involved in a certain problem. To that end, utilitarianism demands a certain level of impartiality in treating individual happiness as compared to the happiness of other beings, as a disinterested spectator. R.N. Langlois makes the connection between utilitarianism and Cost Benefit Analysis (CBA) on two levels: First, utilitarianism as an action. This action is moral when the benefits for the society exceed the costs at the level of the society (Langlois, 1982). Secondly, utilitarianism as a rule. This action implies that the analysis for a cost benefit test should not be applied at the individual level, but rather should be evaluated at the level of a rule or a set of rules. In doing so, the ultimate set of rules will be the one that is going to lead to the highest utility at the social level (Langlois, 1982). The purpose of this study is to determine the costs and benefits of implementing a common uniform between the USN and USMC. This chapter will present the methods utilized for performing a CBA.

1. History of CBA

Alexander Luciana Guta presents a detailed history of the cost benefit analysis model. The origins of the CBA model are rooted in the 1800s, when United States Treasury clerk Albert Galatin proposed a model to analyze and evaluate benefits and costs of investments in naval transport projects (Guta, 2012). Soon after, Jules Dupuit demonstrated the reasonability of civil engineering investments using a model of cost benefit analysis (Guta, 2012). Starting in 1902, the United States began utilizing the method for economic analyses for irrigation projects. From the 1950s and onward, the CBA has been utilized to

evaluate projects including hydropower investment projects, nuclear power plants, refineries, highways, airports, environmental reservations and so on (Guta, 2012). Ultimately, the purpose of using a CBA is to demonstrate that the overall negative impact effects of a project do not outweigh the net benefit for society. There are three primary ways in which to complete a CBA. The ex ante CBA is performed prior to the carrying out of a project. The ex post CBA is performed at the completion of the project to weigh whether or not the decision was worth the cost. Finally, the in media res CBA is performed while the project is still occurring (Boardman, Greenberg, Vining, & Weimer, 2011). For the purposes of this study, the researchers will be completing an ex ante CBA.

2. Steps of CBA

Boardman et al. (2006) provides a thorough description of the steps of a CBA. In the CBA, there are nine total steps.

1. Specify the set of alternatives

Many times, the scope of alternatives is rather large. The number of alternatives depends upon the number of dimensions allowed. In this case, there are eight alternatives analyzed for further evaluation and possible implementation, with each one analyzed in the following sections.

2. Decide whose benefits and costs count

This step involves deciding which perspectives have standing. It answers the question of whose costs or benefits should be counted. It also declares whether the perspective given highest standing will be from the national, state, or local level. In this case, the Marine Corps, the Navy, Congress, and taxpayers would all have standing. The highest standing should be given to the warfighter because they are the end user serving on behalf of the citizens.

3. Catalogue the impacts and select measurement indicators

This step identifies each component of cost and identifies all anticipated impacts to determine if there is a cost or benefit associated with it. In the case of this study that would involve determining unit costs for both the Navy and Marine Corps.

4. Predict the impacts quantitatively over the life of the project

This step identifies the impacts and quantifies them over time. This involves making predictions about each alternative and how great the impact will be over the life of the project. In this case, it would involve estimating how effective the uniform will be at accomplishing mission success over the life cycle of the uniform.

5. Monetize all impacts

This step attaches a dollar value to impact. There may be instances in which it proves rather difficult to assign a value in monetized terms. For the purpose of a CBA, the value should be measured in terms of willingness to pay. When speaking of a market in which there is little willingness to pay, the analyst must research to determine an appropriate value to place on the outcome. In this study, there are aspects that are not monetized. These factors are candidates for further research.

6. Discount benefits and costs to obtain present values

When performing a CBA, the future benefits and costs must be discounted in order to see the present value. In order to combine the accrual of costs or benefits over multiple years, the following formulas may be used:

$$PV(B) = \sum_{t=0}^n \frac{B_t}{(1+s)^t}$$
$$PV(C) = \sum_{t=0}^n \frac{C_t}{(1+s)^t}$$

In this formula, PV(B) is present value of benefits, PV(C) is present value of costs. The number of years is represented by n, while the cost or benefit occurs in year t. The social discount rate, represented by s, is given by the Office of Management and Budget (OMB). The cost or benefit may be converted to a present value when each cost or benefit

is respectively divided by $(1 + s)^t$. This study does not perform this step as there are benefits that do not have quantitative monetary values assigned.

7. Compute the net present value of each alternative

Once the present value has been determined, the net present value of each alternative may be calculated. The net present value is the difference between the present value of the benefits and costs (Boardman et al., (2006).

$$NPV = PV(B) - PV(C)$$

If the NPV is positive, the alternative should be adopted

$$NPV = PV(B) - PV(C) > 0$$

8. Perform sensitivity analysis

Sensitivity analysis attempts to take uncertainties and evaluate them from multiple perspectives. The assumptions of a CBA can be varied, and in some cases, can be varied infinitely. The analyst must deal with important assumptions with keen focus and good judgment. In doing so, the analyst must be certain to avoid biases and uninformed assumptions. This study will examine the effects of maximizing and minimizing all weighted benefits to establish conclusions about the changes that may occur.

9. Make a recommendation

Typically, the analyst will recommend taking the actions of the project with the highest NPV. However, this will not always be the case. There are times when the global perspective and provincial perspective have different alternatives in which the global perspective receives a more preferable weight. In this case, the global perspective may have a smaller NPV, but a more preferable alternative. While the scenario may seem counterintuitive to choose a smaller NPV, it simply means fewer people would enjoy the benefits of choosing the provincial alternative than would from the global perspective.

B. DATA ANALYSIS

In order to begin the data analysis, the courses of action must be declared. The first option in any decision is always to simply keep doing what is already happening. This explains the first COA, which is to maintain the status quo. The research team then recognized that there are FR variants and non-FR versions of both the NWU and MCCUU. This provides four additional options for the Services to begin utilizing. The next set of options would be to differentiate between deployed status and working in garrison. The option should be available to receive the FR variant while deployed, but not in garrison. This would be a possible option for either the NWU FR or the MCCUU FR. The final option considered would be to jointly create a new camouflage pattern that incorporates FR and permethrin treatment to optimize protection and benefits for the warfighter.

1. Courses of Action (COA)

For the sake of this study, the COA options are defined as follows:

- COA 1: Continue status quo with separate uniforms
- COA 2: Navy and Marine Corps use only MCCUU
- COA 3: Navy and Marine Corps use only NWU
- COA 4: Navy and Marine Corps use only MCCUU FR
- COA 5: Navy and Marine Corps use only NWU FR
- COA 6: Navy and Marine Corps use MCCUU in garrison, and MCCUU FR for all deployments
- COA 7: Navy and Marine Corps use NWU in garrison, and NWU FR for all deployments
- COA 8: Navy and Marine Corps implement a new common joint uniform with FR and permethrin-treatment

2. Benefits

In order to perform an analysis of each COA the benefits must be identified. Table 1 lists joint camouflage uniform benefits.

Table 1. Joint camouflage uniform benefits

| Benefits |
|---|
| <ul style="list-style-type: none">• Camouflage• Fire Retardant• Permethrin• Form, Fit, Function• Morale• Program Manager & Contracting Officer Merge |

a. Camouflage

Concealment represents of the factors with utmost importance for the warfighter. The optimized camouflage pattern has a direct impact on mission success and a lowered risk to the warfighter as a result of reduced detection.

b. Fire Retardant

Flame resistant fabrics protect the warfighter in many flash fire environments. This is critical for warfighter safety, whether serving onboard a ship or combat contingency environments.

c. Permethrin

Permethrin-treated fabrics reduces warfighter exposure to adverse diseases when operating in regions more prone to “vector borne” diseases (Bacon, 2010).

d. Form, Fit, Function

The form, fit, function factor measures how adaptable the uniform is to the warfighter and the operating environment. It measures how effectively the uniform performs the intended mission, and its impact on mission success.

e. Morale

Morale increases “esprit de corps” and pride and professionalism. Consolidated uniforms foster a larger sense of belonging, build stronger alliances, and increase collaboration between Navy and Marine Corps.

f. Program Manager/Contracting Officer Merge

Uniform consolidation reduces the need for oversight to one Program Manager. The reduced contracting requirements hold a modest benefit for the Navy and Marine Corps.

3. Costs

In order to assign an appropriate value, the difference between costs and benefits must be identified. Table 2 lists individual uniform costs.

Table 2. Individual uniform costs

| Costs |
|---|
| <ul style="list-style-type: none">• Navy per unit cost• Marine Corps per unit cost |

a. Navy per unit cost

Navy per unit costs are currently \$83.00 for NWUs (Russell, 2012). For the purpose of analysis, researchers are operating under the assumption that the NWU FR uniform pricing follows the cost model of the U.S. Army MultiCam uniform, in which the unit cost is exactly doubled in price of the Army Combat Uniform (Russell, 2012).

b. Marine Corps per unit cost

Marine Corps per unit costs are currently \$77.65 per MCCUU (Russell, 2012). For the purpose of analysis, researchers are operating under the assumption that MCCUU FR uniform pricing follows the cost model of the U.S. Army MultiCam uniform, in which the unit cost is exactly doubled in price of the Army Combat Uniform (Russell, 2012).

4. Identify Impediments

There are multiple levels of impediments to consolidation of Navy and Marine Corps combat uniforms. Analyzed in this paper are four impediments, each listed in Table 3 and discussed in the following section.

Table 3. Impediments to implementation.

| Impediments |
|---|
| <ul style="list-style-type: none">• Berry Amendment• Service Culture• EGA & ACE Removal• Forecasting Problems• Logistics |

a. Berry Amendment

The Berry Amendment, previously mentioned in the Literature Review, restricts the use of foreign suppliers for flame resistant fabric. This can lead to sourcing issues, longer wait times, and higher cost because of limited suppliers.

b. Service Culture

One impediment that must be addressed is the question of whether or not the Marine Corps will have issues with sharing a uniform pattern with another branch of the military. As mentioned in the Literature Review, Solis (2010) states legal barriers presented in “10 U.S.C. 771 prohibits a member of one service from wearing the uniform or distinctive part of the uniform ... belonging to another service” (p. 11). However, if the Marine Corps is willing to allow the MARPAT to be worn by the Padres, there should be no issue in amending the law to allow for commonality in combat uniforms. Furthermore, the Marines’ willingness to share a uniform pattern with an athletic team should transcend also to their fellow military brothers.

c. EGA and ACE Removal

Both COA 2 and COA 3 would require the removal of either the EGA or the ACE prior to distribution for retail sale. While this would be a minor impediment to production, it represents a logistical challenge for the uniforms currently available for sale and in production.

d. Forecasting Problems

One of the fundamental problems that both the Navy and the Marine Corps face is incorrect forecasting for uniform demand that is propagated by poorly drafted fielding plans. This will be a problem that needs to be corrected prior to choosing any COA. Table 4 shows NWU and MCCUU initial production quantities.

Table 4. NWU and MCCUU initial production quantities.
Adapted from MCCUU Pre-Solicitation Conference Slideshow (2016).

| First 30 Months of Production | | | |
|-------------------------------|--------------------------------|------------------|----------------------------|
| | Service Ordered Quantity | Actual Demand | Amount Over Produced |
| MCCUU | 660,000 | 159,640 | 500,360 |
| NWU Type II and III | 1,069,907 | 282,010 | 787,897 |

The fielding plans projected a much higher demand than was actually registered, resulting in unnecessary holding costs at warehouses. While data was not available for MCCUU after the first 30 months, results of the NWU Type II and III show that overproduction continued at a rate of roughly 115% for the first six years of uniform production (Key & Legg, 2015). Improved forecasting would not only reduce the number of warehouses required to hold uniforms, but would also decrease holding costs for excess uniforms on hand.

e. Logistics

One aspect that has not yet been discussed regarding the consolidation of Navy and Marine Corps functional uniforms can be seen through the Program Management office

merger. Decisions on which personnel to retain, key leadership positions, and ensuring the right mix of Navy and Marine Corps military billets and civilian personnel could become an issue for the Services. While the consolidation would create a smaller footprint, the cost reductions from personnel not retained would not discriminate between COAs unless the status quo remains. Regarding distribution costs, there is potential for cost savings in all COAs except the status quo. However, it is not known who the contractor, or contractors, would be that would be awarded future uniform contracts, thereby making it difficult to estimate potential distribution cost savings to the taxpayer.

5. Data Analysis

The following section evaluates the benefits and impediments with regard to each COA.

a. Benefit Performance Scale

The benefit performance scale identifies particular benefits that are present in each COA. When both the Navy and Marine Corps receive the benefit in a given COA, the scale will result in a score of 2. When only one branch receives the benefit in a given COA, the scale will result in a score of 1. When the benefit is not present in a given COA, the scale will result in a score of 0. For example, in COA 5 the FR benefit received a score of 2 because both the Navy and Marine Corps would receive it. Conversely, permethrin received a score of 0 because neither service would receive the benefit. Morale received a score of 1 because the Navy maintains morale at continuing wear of the NWU while the Marine Corps would not. The PM/KO merger benefit measures the ability of the Services to consolidate two production lines into one line. This would result in consolidating into one program office and would reduce the number of contracts, contractors, and contracting officers necessary for procurement. The only COA that does not achieve this benefit is the status quo. Results of the performance scale are listed in Table 5. The greatest number of benefits is found in COA 4.

Table 5. Benefit performance

| | | COA 1 | COA 2 | COA 3 | COA 4 | COA 5 | COA 6 | COA 7 | COA 8 |
|----------|-----------------------|------------|----------------|--------------|-------------------|-----------------|------------------------------------|---------------------------------|--------------------------|
| | | Status Quo | Both Use MCCUU | Both Use NWU | Both Use MCCUU FR | Both Use NWU FR | MCCUU Garrison/MCCUU FR Deployment | NWU Garrison/ NWU FR Deployment | New Common Joint Uniform |
| Benefits | Functionality | | | | | | | | |
| | Camouflage | 1 | 2 | 0 | 2 | 2 | 2 | 0 | 2 |
| | FR | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 2 |
| | Permethrin | 1 | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| | Form/Fit/Function | 1 | 2 | 0 | 2 | 0 | 2 | 1 | 2 |
| | Morale | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | PM/KO Merger | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | |
| | Total Benefits | 5 | 8 | 2 | 10 | 6 | 9 | 4 | 9 |

b. Benefit Evaluation Weights and Rationale

For the purpose of analysis, these weights reflect the values of this research team. Camouflage and FR were given the highest weight because concealment and flame resistant fabric are the most critical factors for the safety of the warfighter. Permethrin and Form, Fit, and Function were rated slightly lower because the adaptability of a uniform is not critical to the safety of the warfighter. However, it still represents a significant benefit that can have an effect on mission success. Morale was given a slightly lower weight because it is only an initial response by the user. Troops will come to accept the uniform change eventually, and in time the morale will not have a significant effect. The benefit of Program Office and Contracting Officer merge received the smallest weight because it only resulted in the consolidation of two program offices into one. The amount of benefit received from this change will not have a significant overall effect. The evaluation factors and benefit weights are listed in Table 6.

Table 6. Weights and rationale

| Evaluation Factor | | Weight | Rationale |
|-------------------|--------------------------|-----------|--|
| Benefits | Camouflage | 22 | Concealment represents of the factors with utmost importance for the warfighter. The optimized camouflage pattern has a direct impact on mission success and a lowered risk to the warfighter as a result of reduced detection. |
| | FR | 22 | Flame resistant fabrics protect the warfighter in many flash fire environments. This is critical for warfighter safety, whether serving onboard a ship or combat contingency environments. |
| | Permethrin | 21 | Permethrin-treated fabrics reduces warfighter exposure to adverse diseases when operating in regions more prone to "vector borne" diseases (Bacon, 2010). |
| | Form/Fit/Function | 20 | The form, fit, function factor measures how adaptable the uniform is to the warfighter and the operating environment. It measures how effectively the uniform performs the intended mission, and it's impact on mission success. |
| | Morale | 10 | Morale increases "esprit de corps" and pride and professionalism. Consolidated uniforms foster a larger sense of belonging, build stronger alliances, and increase collaboration between Navy and Marine Corps. |
| | PM/KO Merger | 5 | Uniform consolidation reduces the need for oversight to one Program Manager. The reduced contracting requirements hold a modest benefit for the Navy and Marine Corps. |

c. Benefit Assessment Score

The benefit assessment score was created by multiplying the benefit performance scale by the evaluation weight. For example, the camouflage benefit in COA 1 received a grade of 1 and a weight of 22, thus resulting in an assessment score of 22. The total assessment score was then tabulated for each respective COA. COA 4 received the highest assessment score with COA 2 and COA 6 showing high assessment scores as well. Benefit assessment scores for all COAs are listed in Table 7.

Table 7. Assessment scores

| | | COA 1 | COA 2 | COA 3 | COA 4 | COA 5 | COA 6 | COA 7 | COA 8 |
|----------|-----------------------|------------|----------------|--------------|-------------------|-----------------|------------------------------------|--------------------------------|--------------------------|
| Benefits | | Status Quo | Both Use MCCUU | Both Use NWU | Both Use MCCUU FR | Both Use NWU FR | MCCUU Garrison/MCCUU FR Deployment | NWU Garrison/NWU FR Deployment | New Common Joint Uniform |
| | Functionality | | | | | | | | |
| | Camouflage | 22 | 44 | 0 | 44 | 44 | 44 | 0 | 44 |
| | FR | 0 | 0 | 0 | 44 | 44 | 22 | 22 | 44 |
| | Permethrin | 21 | 44 | 0 | 42 | 0 | 42 | 0 | 42 |
| | Form/Fit/Function | 20 | 44 | 0 | 40 | 0 | 40 | 20 | 40 |
| | Morale | 20 | 22 | 10 | 10 | 10 | 10 | 10 | 0 |
| | PM/KO Merger | 0 | 22 | 5 | 5 | 5 | 5 | 5 | 5 |
| | | | | | | | | | |
| | Total Benefits | 83 | 176 | 15 | 185 | 103 | 163 | 57 | 175 |

d. Impediments Impact Scale

The scales of impediments identify particular impediments that are present in each COA. When both the Navy and Marine Corps are affected by the impediment in a given COA, the scale will result in a score of 2. When only one branch is impacted, the scale will result in a score of 1. When the impediment is not present in a given COA, the scale will result in a score of 0. For example, in COA 1 the only impediment present is the forecasting problem, but both the Navy and Marine Corps are impacted by it, so the resulting score is 2. Conversely, when considering service culture in COA 2, the score is counted as 1 because the Navy's adaptation to the MCCUU will result in a change to its service culture. Results of the impediments scale are listed in Table 8.

Table 8. COA impediments scale

| | | COA 1 | COA 2 | COA 3 | COA 4 | COA 5 | COA 6 | COA 7 | COA 8 |
|--------------------|--------------------------|------------|----------------|--------------|-------------------|-----------------|------------------------------------|--------------------------------|--------------------------|
| | | Status Quo | Both Use MCCUU | Both Use NWU | Both Use MCCUU FR | Both Use NWU FR | MCCUU Garrison/MCCUU FR Deployment | NWU Garrison/NWU FR Deployment | New Common Joint Uniform |
| Impediments | Berry Act | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Service Culture | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | EGA & ACE Removal | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Forecasting Problems | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | | | | | | | | | |
| | Total Impediments | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 2 |

e. Impediment Evaluation Weights and Rationale

For the purpose of analysis, these weights reflect the values of this research team. Forecasting problems were given the highest weight because it is an issue that impacts every COA, and it is something that needs to be corrected prior to implementing any COA. Service culture was rated slightly lower because it represents a requisite amount of time to develop the necessary ‘esprit de corps’ to embrace the uniform of a different Service. The EGA & ACE removal were rated less because it does not impact the safety of the warfighter or ability to train, but still represents a logistical challenge that must be overcome. The Berry Amendment was the lowest weight because it is easily overcome. It requires collaboration with Congressional leaders to repeal the amendment, or it requires exceptions such as the Ike Skelton Clause. The evaluation factors and benefit weights are listed in Table 9.

Table 9. Impediment weights and rationale

| Evaluation Factor | | Weight | Rationale |
|--------------------|------------------------------|-----------|---|
| Impediments | Forecasting Problems | 60 | Incorrect forecasting for uniform demand that is propagated by poorly drafted fielding plans is a problem that needs to be corrected prior to choosing any COA. None of the COAs will be cost effective if excess costs are wasted in overproduction. |
| | Service Culture | 20 | One impediment that must be addressed is the question of whether or not the Marine Corps will have issues with sharing a uniform pattern with another branch of the military. However, if the Marine Corps is willing to allow the MARPAT to be worn by the Padres, there should be no issue in amending the law to allow for commonality in combat uniforms. |
| | EGA & ACE Removal | 15 | Allowing another Service to wear an existing uniform of a different Branch would require the removal of either the EGA or the ACE prior to distribution for retail sale. While this would be a minor impediment to production, it represents a logistical challenge for the uniforms currently available for sale and in production. |
| | Berry Amendment | 5 | The Berry Amendment prevents the DoD from procuring items not produced in the United States. This law can lead to sourcing issues, longer wait times, and higher cost because of limited suppliers. |

f. Impediment Assessment Scores

The impediment assessment score was created by multiplying the impediment performance scale by the evaluation weight. For example, the forecasting problems impediment in COA 1 received a grade of 2 and a weight of 60, thus resulting in an impediment assessment score of 120. The total assessment score was then tabulated for each respective COA. COA 1 (Status Quo) and COA 8 (New Common Joint Uniform) received the lowest number of impediments. Impediment assessment scores for all COAs are listed in Table 10.

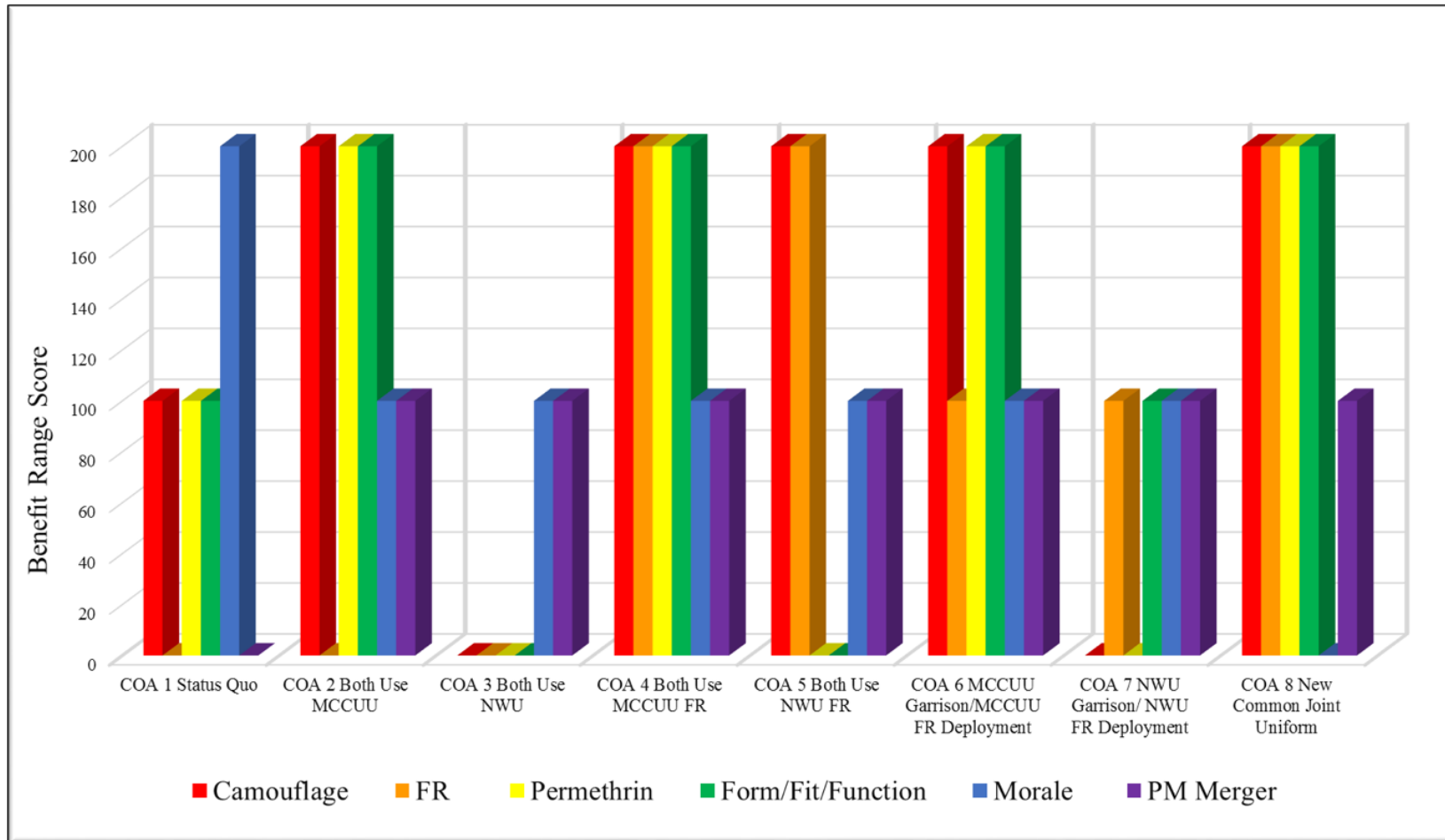
Table 10. Impediment scores

| | | COA 1 | COA 2 | COA 3 | COA 4 | COA 5 | COA 6 | COA 7 | COA 8 |
|-------------|--------------------------|------------|----------------|--------------|-------------------|-----------------|------------------------------------|--------------------------------|--------------------------|
| Impediments | | Status Quo | Both Use MCCUU | Both Use NWU | Both Use MCCUU FR | Both Use NWU FR | MCCUU Garrison/MCCUU FR Deployment | NWU Garrison/NWU FR Deployment | New Common Joint Uniform |
| | Berry Amendment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| | Service Culture | 0 | 20 | 20 | 20 | 20 | 20 | 20 | 0 |
| | EGA & ACE Removal | 0 | 15 | 15 | 15 | 15 | 15 | 15 | 0 |
| | Forecasting Problems | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| | | | | | | | | | |
| | Total Impediments | 120 | 155 | 155 | 155 | 155 | 155 | 155 | 125 |

6. Sensitivity Analysis

In performing sensitivity analysis, the research team evaluated possible effects of minimizing and maximizing each evaluation weight. In order to evaluate the minimized effect, all weights were assumed to have a value of zero. This would result in zero benefits for either service. Conversely, the research team then evaluated the effect of maximizing each evaluation weight. The highest possible evaluation weight any given benefit may receive is 100. Table 11 shows the range of possible effects for each benefit in all COAs.

Table 11. Possible maximum and minimum benefit scores



When the perceived weight of any given benefit was minimized to zero, COA 4 retained the greatest number of benefits. The only exception to this occurred when the FR weight was minimized, it resulted in COAs 2, 4, and 6 tying for the greatest number of total perceived benefits. When the perceived weight of any given benefit was maximized to 100, COA 4 retained the greatest number of benefits. There were no exceptions to this occurrence.

7. Cost

The total unit costs for each branch were calculated by multiplying the end-user unit cost by four uniforms to account for the total number of uniforms that a warfighter maintains. The number four was then multiplied by two in order to account for the number of times the uniforms should be replaced in a given year. The totals were calculated for each branch and then summed to show total costs for each COA, and the results of unit cost calculations are shown in Table 12.

Table 12. Total unit costs. Adapted from Active Duty Military Strength (2018).

| | | | COA 1 | COA 2 | COA 3 | COA 4 | COA 5 | COA 6 | COA 7 | COA 8 |
|----------------------------|--------------------------------|---------|----------------------|----------------------|----------------------|----------------------|----------------------|------------------------------------|---------------------------------|--------------------------|
| | | | Status Quo | Both Use MCCUU | Both Use NWU | Both Use MCCUU FR | Both Use NWU FR | MCCUU Garrison/MCCUU FR Deployment | NWU Garrison/ NWU FR Deployment | New Common Joint Uniform |
| Costs | Marine Corps Unit Cost | | \$77 | \$78 | \$83 | \$155 | \$166 | \$116 | \$125 | \$156 |
| | Navy Unit Cost | | \$83 | \$78 | \$83 | \$155 | \$166 | \$116 | \$125 | \$156 |
| | Marine Corps Total Cost | | \$114,455,667 | \$114,884,728 | \$122,800,160 | \$229,769,456 | \$245,600,320 | \$172,327,092 | \$184,200,240 | \$230,213,312 |
| | Navy Total Cost | | \$216,236,912 | \$202,298,750 | \$216,236,912 | \$404,597,499 | \$432,473,824 | \$303,448,124 | \$324,355,368 | \$405,379,078 |
| | Total Consolidated Cost | | \$330,692,579 | \$317,183,478 | \$339,037,072 | \$634,366,955 | \$678,074,144 | \$475,775,216 | \$508,555,608 | \$635,592,390 |
| | | | | | | | | | | |
| Marine Corps Personnel | | 184,940 | | | | | | | | |
| Navy Personnel | | 325,658 | | | | | | | | |
| Seabag requirement | | 4 | | | | | | | | |
| Replacements sets per year | | 2 | | | | | | | | |

Unit cost for FR variants in COAs 4 and 5 are assumed to be double the cost of the non-FR variant, as modeled after the Army MultiCam.

Unit cost for COA 8 is modeled after the Army MultiCam unit cost of \$155.60.

8. COA Comparison Analysis

In order to conduct a comparison of costs and benefits in each COA, the research team created a table to describe benefits and costs as compared against the status quo. In this way, COA 1 (status quo) is the standard that all other COAs were measured against. COA 2 (both Services utilize MCCUU) is preferred because it provides substantial increase to benefits while decreasing costs. COA 3 (both Services utilize NWU) is not preferred because it decreases benefits from the status quo while increasing costs. COA 4 (both Services utilize MCCUU FR) is preferred because it provides the greatest increase in benefits to the warfighter. COA 5 (both Services utilize NWU FR) is not preferred because it provided a miniscule improvement to benefits while demonstrating a large cost increase. Additionally, this option lacked safety benefits of permethrin treatment. COA 6 (both Services utilize MCCUU in garrison and MCCUU FR deployed) is preferred because it increased benefits by a larger margin than what the costs were increased by. The most heavily weighted safety concerns are addressed in this option. COA 7 (both Services utilize NWU in garrison and NWU FR deployed) is not preferred because the increase in benefits is outweighed by the significant increase in costs. COA 8 (new common joint uniform) is preferred because it increased the benefits to the warfighter significantly. The costs increased, but this can be offset by the benefit of added protection to the warfighter. The overall comparison results are compiled in Table 13.

Table 13. Benefit and cost summary

| COA | | Benefit | Compared to Status Quo Benefit | Cost | Compared to Status Quo Cost | Impediment | Effects |
|-----|--|---------|--------------------------------|---------------|-----------------------------|------------|---|
| 1 | Status Quo | 83 | 100.00% | \$330,692,579 | 100.00% | 120 | The cost is relatively low, and the only impediment is forecasting problems, which is shared by all COA's. However, the benefits received are minimal and not shared by both Services |
| 2 | Both use MCCUU | 158 | 190.36% | \$317,183,478 | 95.91% | 155 | Increase in benefits by 90% while decreasing cost by 5%. |
| 3 | Both use NWU | 15 | 18.07% | \$339,037,072 | 102.52% | 155 | Reasonable number of impediments, but presents the single poorest performance in terms of net benefits. This COA actually loses over 80% of the benefits currently held in status quo, while still increasing costs from the status quo by over 2%. |
| 4 | Both use MCCUU FR | 185 | 222.89% | \$634,366,955 | 191.83% | 155 | Demonstrates a 91% cost increase over the status quo. However, it also increases the amount of benefits by over 120% from the status quo, resulting in the the greatest amount of benefits. Also shows a reasonable number of impediments. |
| 5 | Both use NWU FR | 103 | 124.10% | \$678,074,144 | 205.05% | 155 | Reasonable number of impediments, but increases cost by over 105% while only increasing benefits by 24%. |
| 6 | MCCUU Garrison/ MCCUU FR Deployment | 163 | 196.39% | \$475,775,216 | 143.87% | 155 | Increases benefits by 96%, but increases costs by 43%. |
| 7 | NWU Garrison/NWU FR Deployment | 57 | 68.67% | \$508,555,608 | 153.79% | 155 | Demonstrates a decrease in benefits by 32% while increasing costs by over 53%. |
| 8 | New Common Joint Uniform | 175 | 210.84% | \$635,592,390 | 192.20% | 125 | Increase in cost by 92%, but demonstrates over 110% increase in benefits. |

THIS PAGE INTENTIONALLY LEFT BLANK

V. SUMMARY, CONCLUSIONS, RECOMMENDATIONS

A. SUMMARY

The purpose of this project was to investigate the potential savings of consolidating Navy and Marine Corps uniforms into one functional uniform. The specific focus was performing a CBA that would evaluate the current method for uniform procurement against multiple options for a consolidated uniform.

In Chapter II, the authors reviewed uniforms worn by Navy and Marine Corps service members, beginning with the Olive Green Shade 107 uniform first worn in 1952 and concluding with the Navy's Improved Flame Resistant Variant coverall introduced in 2018. Most uniforms are introduced to provide greater camouflage protection, but individual service identification via service-specific uniforms has played a significant role in the number of new uniforms worn. As the numerous demands of the end users continue, specifically functionality and protection, there will be an increased focus from senior leadership to collaborate with other services for a common combat uniform to follow Fiscal Year 2014's National Defense Authorization Act.

In Chapter III, the authors discussed key stakeholder roles and responsibilities in camouflage uniform development, testing and the acquisition process of the NWU Type II, NWU Type III and the MCCUU camouflage uniforms. The 2014 NDAA pressures all Services to seek future cost savings in uniform development through partnerships and improved collaboration across the DoD. Studies conducted by the GAO between 2010 and 2013 evaluated the effectiveness of each Service's fragmented approach, which lead to increased visibility of the acquisition decision making processes. As a result, Dodaro's (2018) GAO Government Efficiency and Effectiveness report to Congress indicated cost benefits with a reduction in the number of uniforms variants and patterns across the Services. In his report, United States Comptroller General Dodaro (2018) testified that when it pertains to combat uniforms, "[t]he Department of Defense (DoD) could potentially save approximately \$527 million over 5 years by minimizing unnecessary overlap and duplication" (p. 2).

In Chapter IV, the research team examined the methodology for analyzing total unit costs and possible benefits. The research team explored eight possible options for consolidating uniforms into one functional combat uniform and it was determined that shifting both the Navy and Marine Corps to the MCCUU FR variant achieved the greatest number of benefits, along with the greatest weighted benefits. Benefits analyzed include camouflage, flame resistant fabrics, permethrin treatment, and form, fit, and function. The authors examined how the impact of the perceived benefits would change when the benefit weights were increased or decreased.

1. Conclusions

The research team set out to answer two research questions. The primary research question asked if there are benefits to the consolidation of Navy and Marine Corps combat and working uniforms into a common functional uniform. The research team concluded that there are many possible benefits to consolidation. Added benefits for the Navy include increased concealment, safety, and functionality. Additionally, the Navy would see an advantage of better unit costs for end-users by adopting the MCCUU. After analyzing eight possible options, the research team concluded that COA 3 (both Services utilizing NWU), COA 5 (both Services utilizing NWU FR), and COA 7 (both services utilizing NWU in garrison and NWU FR for deployment) are not reasonable alternatives because the amount of benefits gained did not outweigh the analyzed total unit costs. COAs 4 (both Services utilizing MCCUU FR), 6 (both Services utilizing MCCUU in garrison and MCCUU FR on deployment), and 8 (both Services utilizing a new common joint uniform) performed similarly on analyzed total unit costs, but COA 4 resulted in the greatest number of benefits and the highest weight of perceived benefits.

The second research question for the research team was to identify the impediments related to the adoption of a single functional uniform. Impediments identified include the Buy American Act, individual Service culture, EGA & ACE removal, uniform forecasting, and logistics issues. The research team identified that these issues can cause sourcing problems, low morale at the onset of the uniform shift, and can lead to continued

overproduction and excess costs. However, each impediment identified can be overcome with Congressional support and improved collaboration between Services.

2. Recommendations

The research team examined eight possible COAs to analyze consolidation of uniforms into one functional uniform, resulting in two primary recommendations.

a. Recommendation for NEXCOM and MARCORSYSCOM

The research team recommends that NEXCOM modify the uniform fielding plans to a method that more reasonably reflects the actual demands of the Fleet. Key & Legg (2015) research developed a non-smoothing non-exponential (NSNE) M2 model that was proven capable of more accurately forecasting rates of adoption and demand. The implementation of this new model will contribute to reduced holding costs for warehouses. Until the fielding plan models are corrected, it does not make financial sense to adopt any of the analyzed courses of action.

b. Recommendation for the Navy and Marine Corps

The research team recommends the Navy and Marine Corps each administer a survey to all service members. The survey should seek to establish the current climate with regard to uniforms and a willingness to change. The research team recommends the Navy strongly consider shifting to COA 4 and adopting the MCCUU FR uniform for all personnel. On the survey, all viable options should be presented to service members in order to establish receptivity by Navy and Marine Corps personnel. While it is demonstrated that COA 4 does not have the lowest cost, it has the greatest number of benefits and highest weight of benefits for the warfighter. Ultimately, COA 4 involves shifting to a uniform that is proven to be effective, and it will provide the highest level of safety and concealment to the warfighter.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

- About NWU Type II & Type III. (n.d.). Naval Supply Systems Command. Retrieved from https://www.navsup.navy.mil/public/navsup/nexcom/nwu_type_ii_iii/
- Active Duty Military Strength by Service. (2018, March 31). Retrieved May 15, 2018, from https://www.dmdc.osd.mil/appj/dwp/dwp_reports.jsp
- Admiral Calland's desert combat uniform top. (2012, July 23). Retrieved from <https://www.cia.gov/about-cia/cia-museum/experience-the-collection/index.html#!/artifact/55>
- Bacon, D. (2010, October 13). Expeditionary Marines counter mosquito's lethal bite. Retrieved from <http://www.26thmeu.marines.mil/News/News-article-display/article/516566/expeditionary-marines-counter-mosquitos-lethal-bite/>
- Blechman, H. (2013, August 6). The complex guide to camo. Retrieved from <http://www.complex.com/style/2013/08/guide-to-camouflage/>
- Boardman, A. E., Greenberg, D. H., Vining, A.R., & Weimer, D.L. (2006). Cost-benefit analysis: Concepts and practice. Upper Saddle River, NJ: Pearson/Prentice Hall.
- Brown, D.W. (2013, January 17). Why is the Marine Corps fighting with the Navy over a camouflage uniform? *The Atlantic*. Retrieved from <https://www.theatlantic.com/national/archive/2013/01/why-is-the-marine-corps-fighting-with-the-navy-over-a-camouflage-pattern/267232/>
- Browne, M. (2016, November 9). Marines, Sailors get upgrades to flame resistant uniform. <http://www.marcorsyscom.marines.mil/News/News-Article-Display/Article/1000218/marines-sailors-get-upgrades-to-flame-resistant-uniform/>
- Center, B. (2011, January 25). New uniforms make Padres' military tribute harder to see. *San Diego Tribune*. Retrieved from <http://www.sandiegouniontribune.com/sports/padres/sdut-padres-new-camouflage-uniforms-make-military-trib-2011jan25-story.html>
- Chief of Naval Operations. (2008, December 8) *Uniform update* (NAVADMIN 343/08). Washington, DC: Author. Retrieved from <http://www.public.navy.mil/bupers-npc/reference/messages/Documents2/NAVADMIN2/NAV2008/NAV08343.txt>
- Chief of Naval Operations. (2011, August 30). *Navy working uniform type I, II, and III, camouflage utility uniforms* (NAVADMIN 259/11). Washington, DC: Author. Retrieved from <http://www.public.navy.mil/ia/documents/NAV25911.htm>

- Chief of Naval Operations. (2017, August 31) *Navy working uniform type III and Navy working boots update* (NAVADMIN 214/17). Washington, DC: Author. Retrieved from <http://www.public.navy.mil/bupers-npc/reference/messages/Documents/NAVADMINS/NAV2017/NAV17214.txt>
- Collins, E. M. (n.d.). Battle dress through the centuries. *Soldiers Magazine*. Retrieved from <http://soldiers.dodlive.mil/2015/06/battle-dress-through-the-centuries/>
- Commandant of the Marine Corps. (2002, May 20) *Combat utility uniform and boot guidance* (ALMAR 028/02). Washington, DC: Author. Retrieved from <http://www.marines.mil/News/Messages/Messages-Display/Article/887056/combatt-utility-uniform-and-boot-guidance/>
- Department of the Army. (2010). *Camouflage, concealment, and decoys* (FM 20–3). Washington, DC: Author. Retrieved from <https://fas.org/irp/doddir/army/attp3-34-39.pdf>
- Department of Defense. (2007, November 20). *The defense acquisition system* (DoD Directive 5000.01). Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. Retrieved from <http://acqnotes.com/acqnote/acquisitions/dodd-5000>
- Department of Defense. (2017, September 15). *Management of DoD clothing and textiles* (DoD Directive 4041.63). Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. Retrieved from https://www.acq.osd.mil/log/sci/policy_vault_issuances.html
- DLA Troop Support Clothing & Textiles. (2017). Defense Logistics Agency. Retrieved from <http://www.dla.mil/TroopSupport/ClothingandTextiles.aspx>
- Dodaro, G. L. (2018). 2018 Annual Report: Additional Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits (GAO-18-371SP). Washington, DC: Government Accountability Office.
- Durando, J. (2014, August 4). A brief history of U.S. military camouflage. Retrieved from <https://www.usatoday.com/story/news/nation-now/2014/08/01/history-camouflage-military-united-states/13485491/>
- Faram, M. D. (2017, August 22). The Navy's woodland cammies: The roll-out plan & how to wear them right. Retrieved from <https://www.navytimes.com/news/your-navy/2016/10/23/the-navy-s-woodland-cammies-the-roll-out-plan-how-to-wear-them-right/>
- FY2018 Military Clothing Allowances. (2017, December 7). <https://www.dfas.mil/militarymembers/payentitlements/FY2018ClothingAllowance.html>

- Grasso, V. B. (2014). *Military Uniform Procurement: Questions and Answers* (CRS Report No. RS20550). Retrieved from Congressional Research Service website: <https://fas.org/sgp/crs/natsec/RS20550.pdf>
- Guta, L. (2012). The Cost-Benefit Analysis and Its Economic Philosophy. SSRN Electronic Journal. doi:10.2139/ssrn.2152639
- Imperial War Museum Staff. (2018, January 11). 5 facts about camouflage in the first World War. Retrieved from <https://www.iwm.org.uk/history/5-facts-about-camouflage-in-the-first-world-war>
- Key, M., & Legg, A. (2015). Developing A Universal Navy Uniform Adoption Model For Use in Forecasting (Unpublished master's thesis). Monterey/Naval Postgraduate School. doi:https://calhoun.nps.edu/bitstream/handle/10945/47983/15Dec_Key_Legg.pdf?sequence=1&isAllowed=y
- Langlois, R. N. (1982), "Cost – Benefit Analysis, Environmentalism, and Rights," *Cato Journal*, Vol. 2, No. 1, pp. 279 – 304.
- Marine Corps Base Camp Pendleton. (2008, January 19). Camp Pendleton photo gallery. Retrieved from <http://www.pendleton.marines.mil/Photos/igphoto/250358/>
- Marine Corps Systems Command. (n.d.). Command Overview. Retrieved from <http://www.marcorsyscom.marines.mil/About-Us/Overview-and-History/>
- MCCUU Pre-Solicitation Brief. (2016, May 10). Retrieved May 20, 2018, from <https://www.fbo.gov/utils/view?id=9ac8b8f64dd708dd4b017e3032f6a0b6>
- Melissa Rathbun-Nealy's "chocolate chip" pattern battle dress uniform. (n.d.). Smithsonian National Museum of American History. Retrieved from <https://amhistory.si.edu/militaryhistory/collection/object.asp?ID=11>
- Men's San Diego Padres Majestic camo 2018 Jackie Robinson Day authentic flex base jersey. (n.d.). Major League Baseball Shop. Retrieved from <https://www.mlbshop.com/san-diego-padres/mens-san-diego-padres-majestic-camo-2018-jackie-robinson-day-authentic-flex-base-jersey/t-25129926+p-6900373010703+z-9-2617558724>
- Mill, J. S. (1863). *Utilitarianism*. London: Parker, Son, and Bourn.
- National Defense Authorization Act for Fiscal Year 2010, Pub. L. No. 111–84, §352, Stat. 2262 (2011). Retrieved from <https://www.gpo.gov/fdsys/pkg/PLAW-111publ84/html/PLAW-111publ84.htm>
- National Defense Authorization Act for Fiscal Year 2014, Pub. L. No. 113–66, §127 Stat. 742 (2013). Retrieved from <https://www.congress.gov/113/plaws/publ66/PLAW-113publ66.pdf>

- NAVFAC. (n.d.). Expeditionary. Retrieved March 07, 2018, from https://www.navfac.navy.mil/products_and_services/ex/products_and_services/SYSCOM/uniforms.html
- NAVSUP. (n.d.). Navy Exchange Service Command Org chart. Retrieved March 06, 2018, from <https://www.navsup.navy.mil/site/public/nexcom/documents/orgchart-aug16.pdf>
- Navy Working Uniform Program Transferred to NAVSUP. (2014, October 24). Naval Facility Engineering Command. Retrieved from https://www.navfac.navy.mil/products_and_services/ex/news/2013/NNS141024-12.html
- NEXCOM. (n.d.a.). Uniform Program Management Office. Retrieved March 06, 2018, from <https://www.navsup.navy.mil/public/navsup/nexcom/umpo/>
- NEXCOM. (n.d.b.). Navy Clothing and Textile Research Facility. Retrieved March 06, 2018, from <https://www.navsup.navy.mil/public/navsup/nexcom/nctrf/>
- NWU Q & A. (n.d.). Naval Supply Systems Command. Retrieved from https://www.navsup.navy.mil/public/navsup/nexcom/nwu_qa/
- O'Dwyer, G. (2017, December 8). Landmark agreement on combat uniform procurement deepens Nordic collaboration. Retrieved from <https://www.defensenews.com/global/europe/2017/12/08/landmark-agreement-on-combat-uniform-procurement-deepens-nordic-collaboration/>
- Organizational clothing and privately owned protective clothing. (n.d.). Navy Personnel Command. Retrieved from <http://www.public.navy.mil/bupers-npc/support/uniforms/uniformregulations/chapter6/Pages/6801.aspx>
- Padres unveil new U.S. Navy digital camouflage jersey. (2015, December 1). Fox Sports. Retrieved from <https://www.foxsports.com/san-diego/story/padres-unveil-new-u-s-navy-digital-camouflage-jersey-120115>
- Permethrin treated clothing. (2017, December 21). National Pesticide Information Center. Retrieved from <http://npic.orst.edu/pest/mosquito/ptc.html>
- Program Manager Infantry Combat Equipment. (2018). Marine Corps Systems Command: Equipping our marines. Retrieved from www.marcorssyscom.marines.mil/Portfolios-and-Programs/GCES/PMICE/
- Randolph, M. (2017, October 26). Corps reaches final stages of tropical boots, uniform testing. Retrieved from <http://www.marcorssyscom.marines.mil/News/News-Article-Display/Article/1354749/corps-reaches-final-stages-of-tropical-boots-uniform-testing/>

Russell, C. B. (2012). *Warfighter support: DoD should improve development of camouflage uniforms and enhance collaboration among the services* (GAO-12-707). Washington, DC: Government Accountability Office.

Sanborn, J. K. (2015, April 12). Corps tests new camo the enemy won't be able to spot. Retrieved from <https://www.marinecorpstimes.com/news/your-marine-corps/2015/04/12/corps-tests-new-camo-the-enemy-won-t-be-able-to-spot/>

Santos, L. M., Townes, D. E., Patricio, G. R., Winterhalter, C.A., Dugas, A., O'Neill, T. R., ..., Quinn, B. J. (2004). *U.S. Patent No. 6805957*. Washington, DC: U.S. Patent and Trademark Office. Retrieved from <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=%2Fnetahhtml%2FFPTO%2Fsrchnum.htm&r=1&f=G&l=50&s1=6805957.PN.&OS=PN/6805957&RS=PN/6805957>

Solis, W. M. (2010). *Warfighter support: Observations on DoD's ground combat uniforms* (GAO-10-669R). Washington, DC: Government Accountability Office.

Solis, W. M. (2011). *Military uniforms: Issues related to the supply of flame resistant fibers for the production of military uniforms* (GAO-11-682R). Washington, DC; Government Accountability Office.

Suciu, P. (2015, October 21). The evolution of U.S. military camouflage: From basic green and khaki to digital patterns and beyond. Retrieved from <http://www.foxnews.com/tech/2015/10/21/evolution-us-military-camouflage-from-basic-green-and-khaki-to-digital-patterns-and-beyond.html>

Task Force Uniform Public Affairs. (2012, December 20). Navy working uniforms (NWU) concepts frequently asked questions. Retrieved from http://www.navy.mil/submit/display.asp?story_id=16603

United States Army. (2017, November 8). U.S. Army Natick Soldier Research, Development and Engineering Center. Retrieved April 07, 2018, from <https://www.army.mil/standto/2017-11-08>

United States Fleet Forces. (2012, December 12). *Navy working uniform* (USFF GENADMIN DTG 120737Z DEC 12). Norfolk, VA: Author. Retrieved from <http://navylive.dodlive.mil/2012/12/12/navy-working-uniform/>

United States Fleet Forces. (2013, October 24). *Introduction of the flame resistant variant coverall and roll-out plan to the fleet* (USFF GENADMIN DTG 241800Z OCT 13). Norfolk, VA: Author. Retrieved from <http://www.navy.mil/docs/frv%20coverall%20message.pdf>

United States Fleet Forces. (2017, January 19). *Announcing approval of the Improved Flame Resistant Variant (IFRV) coverall* (USFF GENADMIN DTG 191900Z JAN 17). Norfolk, VA: Author. Retrieved from <http://www.public.navy.mil/bupers-npc/support/uniforms/Documents/COMUSFLTFORCOM%20R%20191900Z%20JAN%2017.pdf>

USGI woodland BDU blouse. (n.d.). Double Tap Military Surplus. Retrieved from <https://doubletapsurplus.com/products/usgi-woodland-bdu-blouse>

Utilities / jungle fatigues. (n.d.). Moore Militaria. Retrieved from <http://www.mooremilitaria.com/utilities-fatigues.html>

Vergakis, B. (2017, January 20). Navy to issue new lightweight, flame-resistant coveralls to sailors at sea. Retrieved from https://pilotonline.com/news/military/local/article_e918e8e8-2eba-50eb-886d-2c357015ede7.html

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California